



EXPLORE!
DISCOVER!
LEARN!



SCIENCE

FOR PRIMARY

6



FUN
EXPERIMENTS!
AMAZING
FACTS!



Watermarkly



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Primary 6 Science



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How Things Burn and Air

Chapter 1 Conditions for Burning



Question

What will happen to the candle's flame inside if you put a lid on the jar?



Short Answer

The candle's flame will become **smaller** and may **go out**.



Key Points



Air is important for burning.



Fire needs **oxygen** to burn.



Less oxygen means a **smaller** flame.



No oxygen means the flame **goes out**.



What's Happening?

- A flame needs air (oxygen) to keep burning.
- When the jar is covered with a lid, the air inside becomes less and less.
- The flame gets less oxygen, so it becomes smaller.
- When there is no more oxygen, the flame goes out.



Can fire burn without air?



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★ Point!



For things to keep burning, fresh **air** must constantly flow in and out. In a place where the air is not replaced, things **cannot keep burning**.



Experiment of burning things inside a jar

• When not covered with a lid:

Fresh air is supplied from the surroundings, so the candle **keeps burning**.

• When covered with a lid:

Once the air inside the jar is used up, the flame will **go out**.



Warm Up

Let's keep things burning in various ways!

Let's do an experiment about how air works when things burn.

1

Preparation:



2

Experiment:

- Spread the clay flat on the board.
- Stand a candle on the clay, light it, and cover it with the bottomless gas jar.

- 1 What happens to the flame when you put a lid on the jar?
- 2 What happens when you cut the clay to create a gap at the bottom?
- 3 What happens when you take off the lid to make gaps at both the top and bottom?

1



2



3



3

Summary:



The candle needs fresh air to keep burning. When air cannot enter or leave, the flame goes out. Air moving in and out keeps the flame alive.



Chapter 1

The Role of Oxygen

Conditions for Burning



Q What is burning?

A Burning is a process that produces **heat and light**.

Q What are the conditions for burning?

A For burning to happen, we need:

- **Fuel**
- **Heat**
- **Oxygen (from the air)**

Look & Learn



The incense stick burns brightly inside the jar.

This shows that **oxygen** in the air helps things burn.

Key Fact

Oxygen is a gas in the air that helps things burn.



Q Which gas in the air helps things burn?

The incense stick is **burning brightly!**
I wonder what the secret is.



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1-2 The Role of Oxygen

Conditions for Burning



Key Point!

Air is a mixture of gases like **nitrogen**, **oxygen**, and **carbon dioxide**.

Components of Air

Nitrogen
(about 78%)

Oxygen
(about 21%)

Carbon dioxide
(about 0.04%),
etc.



Q: Which gases help things burn?

A: **Oxygen** has the power to help things burn,
but **nitrogen** and **carbon dioxide** do not.



Warm Up

Let's see the differences in burning
caused by different gases!



1 Preparation

- ✓ Nitrogen gas cylinder
- ✓ Carbon dioxide gas cylinder
- ✓ Water tank filled with water
- ✓ Combustion spoon
- ✓ Oxygen gas cylinder
- ✓ 3 gas jars
- ✓ 3 lids
- ✓ Bendy straw
- ✓ Candle
- ✓ Gas lighter



2 Experiment

- 1 Put nitrogen, oxygen, and carbon dioxide into the 3 jars, respectively.

How to collect the gas

Turn the water-filled jar upside down in the water, fill 70% of it with the gas, and put the lid on.



- 2 Stand a candle on the combustion spoon, light it, quickly put it into the jar, and put the lid on.
- 3 Observe how the candle's flame burns.

3 Summary

- Summarize the state of the candle and flame in each of the three jars.



Key Fact: **Oxygen** supports burning. Without **oxygen**, things cannot burn.

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- 1 1 What happens to the flame if you put a lid on the jar to stop air from coming in and out?

A: The flame becomes smaller and then **goes out**.



- 2 Why did the flame go out inside the jar with the lid? Choose the correct answer.

A: Because there was no water vapor in the jar.

B: Because it got dark inside the jar.

C: Because fresh air stopped coming in. ✓

Key Fact

Fire needs fresh air (**oxygen**) to keep **burning**.



- 2 1 What gas is included in the air and has the power to help things burn?

A: The gas is **oxygen**.



- 2 What happens when you put a lit incense stick into a jar of oxygen? Choose the correct answer.

A: It becomes weaker.

B: It burns brightly. ✓

C: The flame goes out.



- 3 What happens when you put a lit incense stick into a jar of carbon dioxide? Choose the correct answer.

A: It keeps burning as it is.

B: It burns brightly.

C: The flame goes out. ✓



Remember!

- ★ **Oxygen** helps things burn.
- ★ Fire needs **fresh air**.
- ★ **Carbon dioxide** does not support burning.





EXERCISE

- 1 (1) In the experiment of burning a candle inside a jar, what happens to the flame if you leave gaps at the top and bottom of the jar?

Choose the correct answer from below.

- A It keeps burning.
B It goes out immediately.



- (2) Fill in the blanks with the correct words.



For things to keep burning, fresh (① _____) must constantly flow in and out.



In a place where air is not replaced, things (② _____) keep burning.

- 2 (1) What happens to the burning when you put a lit incense stick into a jar of nitrogen? Choose the correct answer from below.

- A It keeps burning as it is.
B It burns brightly.
C The flame goes out.



- (2) Which statement correctly explains oxygen? Choose the correct answer from below.

- A Oxygen makes up about 78% of the air.
B Oxygen helps other things burn.
C When you put a candle in a jar with oxygen, the flame goes out immediately.



Oxygen

- ✓ Helps things burn
- ✓ Makes up about 21% of the air



Key Fact

Fresh air (with **oxygen**) must flow in and out for things to burn.
Without **oxygen**, things **cannot keep burning**.





Air After Burning

Chapter 1

Conditions for Burning



? Question

What kind of changes happen to the air after things burn?

✓ Short Answer

After things burn, the air inside the jar changes.



★ Key Points



Burning uses **oxygen** from the air.



Carbon dioxide and water vapor are produced.



The air may feel **warm** or different.



We need **fresh air** for healthy breathing.



What's Happening?

- 1 When the candle burns, it uses **oxygen** from the air.
- 2 **Carbon dioxide** and water vapor are formed.
- 3 These new gases **change** the composition of the air.
- 4 That is why the air after burning is **not the same** as before.



“ I want to see how the composition of air changes before and after burning. ”



Remember!

Burning needs **air**. After burning, the air changes.

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1-3 Air After Burning

Conditions for Burning

Chapter 1

★ Point!

When things burn, a part of the **oxygen** in the air is used, and **carbon dioxide** is produced.



Oxygen

The amount **decreases** because it is used when things burn.



Carbon dioxide

The amount **increases** because it is newly produced when things burn.



How do we check for carbon dioxide?

- We use **limewater** to check if there is carbon dioxide.
- Colorless and clear limewater turns **milky white** when it reacts with carbon dioxide.



Before



After



Warm Up

Let's check the change in air with limewater!

1 Preparation:



2 gas jars



Lids



Candle



Combustion spoon



Limewater



Safety goggles



Gas lighter

2 Experiment:

- 1 Put limewater into each of the 2 jars.
- 2 Put a lit candle into one jar, put the lid on, and wait until the flame goes out.
- 3 After taking out the candle, shake the 2 jars.



CAUTION!

Wear safety goggles so the limewater doesn't get in your eyes.



3 Compare:

Let's check the color change of the limewater in the 2 jars.



Jar without candle



Jar with candle

The limewater turns **milky white** when carbon dioxide is present!



Key Takeaway

- ✓ **Oxygen** is used up when things burn.
- ✓ **Carbon dioxide** is produced when things burn.
- ✓ Limewater turns **milky white** in the presence of carbon dioxide.



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Try

1 Answer the following questions about the air after things burn.

① What gas has increased?

.....

② What gas has decreased?

.....

2 What is the colorless and clear liquid used to check if there is carbon dioxide?

.....



Exercise

1 What happens when you put limewater in a jar with increased carbon dioxide and shake it?

Choose the correct answer from below.

A It turns blue.

B It turns yellow.

C It turns milky white.



2 How does the amount of oxygen change after burning?

.....



3 How does the amount of carbon dioxide change after burning?

.....



Key Fact

After burning:

- Oxygen in the air decreases.
- Carbon dioxide in the air increases.



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Let's Expand!



What kind of tools are there to check gases?

1 Gas Detector Tube



- Inside the glass tube, there is a **chemical** that changes color when it reacts to a specific gas.
- By reading the scale where the color has changed, you can **measure** the amount of the gas.
- The type of tube to use is different for **oxygen** and **carbon dioxide**.



Caution!

The glass tube is single-use only. Also, be careful not to get hurt by the broken ends.

How to use

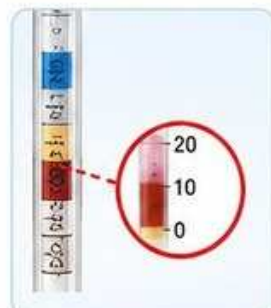
- 1 Ask your teacher to break off both ends of the glass tube, then insert it firmly into the gas sampling pump.



- 2 Pull the handle of the pump fully, and wait for a certain amount of time. Then, the chemical inside reacts and changes color.



- 3 Read the number at the border where the color changed. This is the percentage of that gas included in the air.



2 Gas Monitor

- It uses a **sensor** to show the percentage (%) of the gas on the screen in digital numbers.
- There are types that can measure both **oxygen** and **carbon dioxide** at the same time, which is very useful.



Key Fact: **Oxygen** supports burning.
Without **oxygen**, things cannot burn.



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CHAPTER 1

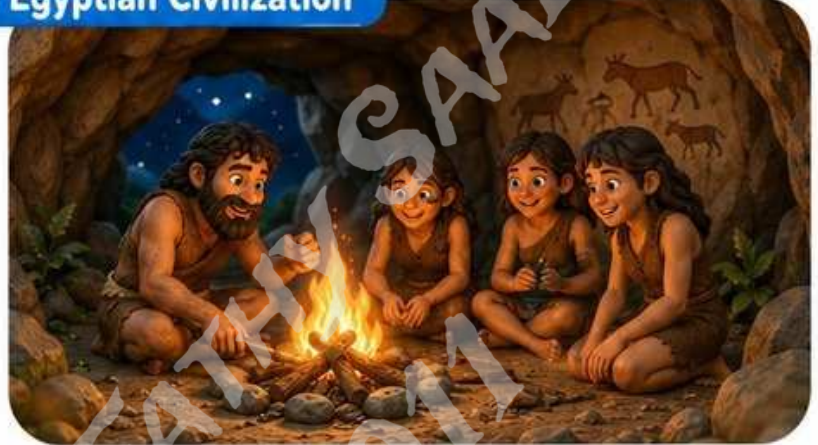
Column: Combustion and Future Energy



1 The Discovery of Fire and Egyptian Civilization

Q Why was discovering fire important for humans?

A Learning to use fire was a major step for human civilization.
Things need **oxygen** to burn.
We learned that in this chapter!



Ancient "Lights"



- **Ancient Egyptians** developed clever ways to use fire.
- They used **oil lamps** to light temples and tombs.
- Their designs let **air** reach the flame, which is essential for burning.
- Their daily life and **wisdom** matched the rules of science—even without modern tools!



3 The Role of Oxygen in Combustion

Q What happens when there is plenty of oxygen?

A Things burn intensely when there is plenty of **oxygen**.

- Ancient craftsmen used **bellows** (a tool for blowing air) to pump air into the fire.
- This supplied more **oxygen** to the fire.
- The fire became **hotter**.
- They **melted** gold at high temperatures.
- They made beautiful **jewelry**!



Key Fact

Fire needs **oxygen** to burn. With more **oxygen**, the fire burns **stronger** and **hotter**!





2

Ways to Reduce Carbon Dioxide Emissions

Burning things produces carbon dioxide. Today, too much of this gas is one of the causes of “global warming”.



1 Energy Without Burning

Instead of burning oil and coal, Egypt is now gaining attention from around the world for using “renewable energy” from the sun and wind.



2 Benban Solar Park

The knowledge about combustion we learned in Chapter 1 is being used in a different way (generating electricity without burning) to protect the Earth. A giant solar power plant in Aswan brings light to Egyptian homes without producing any carbon dioxide.



From the wisdom of mastering fire, to the wisdom of generating energy without it. The progress of science will save the future of our Earth!



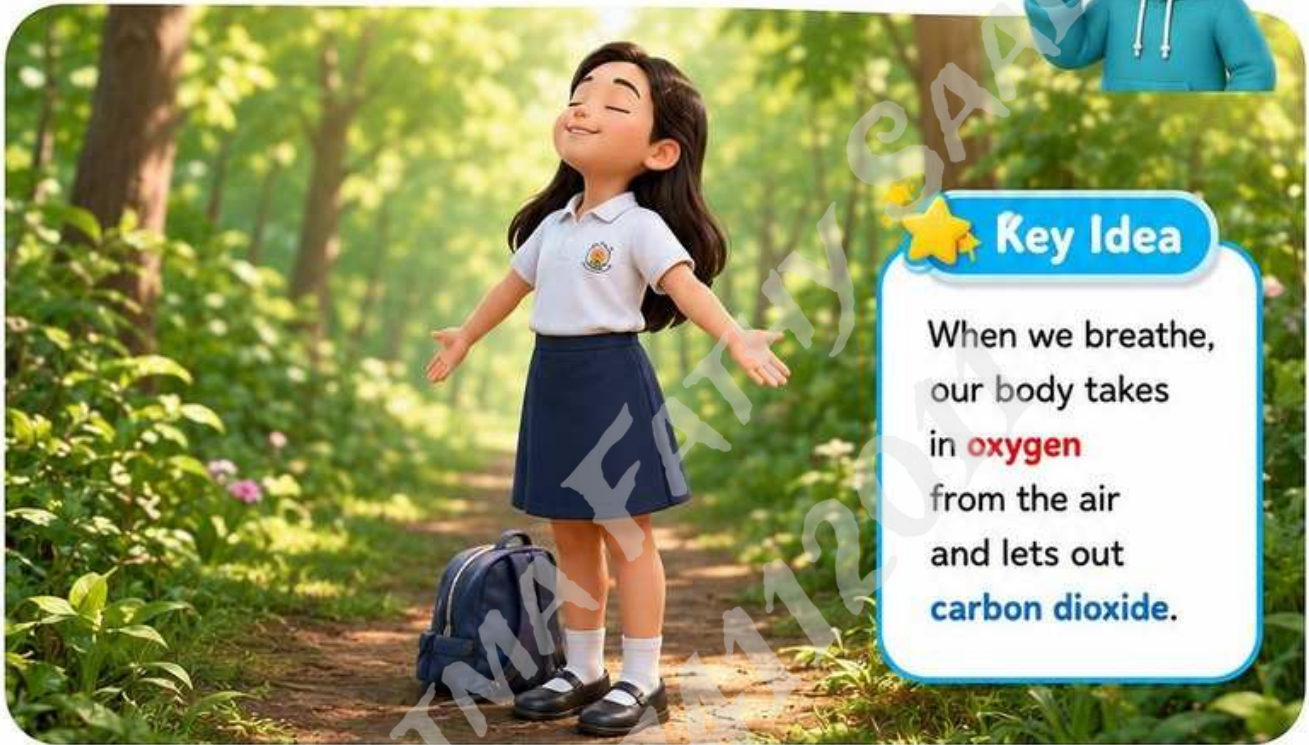
Key Takeaway

- ✓ Burning produces **carbon dioxide**, which causes global warming.
- ✓ We can use **renewable energy** from the sun and wind.
- ✓ Science helps us **protect our Earth** and build a better future.



How Breathing Works

Respiration



Key Idea

When we breathe, our body takes in **oxygen** from the air and lets out **carbon dioxide**.

?

What do we **take in** from the air and what do we **let out** when we breathe?

Is the air we **breathe in** different from the air we **breathe out**?



I wonder if there is something our body **needs** in the air.



Did You Know?

We breathe about **20,000** times every day!





2-1 How Breathing Works



We breathe in and out all the time!



Key Idea

- People breathe in and out to take in some of the **oxygen** from the air and let out **carbon dioxide**.
- Taking in oxygen and letting out carbon dioxide is called **breathing**.



Let's Explore!

Let's check what is in the air we breathe out!

1 What do we need?

- ✓ Plastic bags (Polyethylene bags)



- ✓ Gas detector tubes (for carbon dioxide / for oxygen)



- ✓ Gas sampling pump



- ✓ Limewater



- ✓ Safety goggles



- ✓ Scissors



2 Test with limewater

- 1 Prepare two plastic bags.

- 2 Breathe into one bag, and fill the other bag with room air.

- 3 Pour a little limewater into each bag and shake them well.

→ What can you learn from how the limewater changes?



3 Test with gas detector tubes

Just like in step 2, use gas detector tubes to check the amount of oxygen and carbon dioxide in the air inside the bags.



Make a small hole in the bag with scissors.

4 Compare the results

Compare the amounts of oxygen and carbon dioxide in the air around us and the air we breathe out.

Gas	Air Around Us (Room Air)	Air We Breathe Out (From Lungs)
Oxygen (O ₂)	Higher ● ● ● ● ●	Lower ● ● ● ● ●
Carbon dioxide (CO ₂)	Lower ● ● ● ● ●	Higher ● ● ● ● ●



Key Fact

When we breathe, we take in **oxygen** and give out **carbon dioxide**.

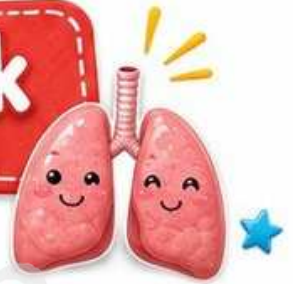


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How Lungs Work

Chapter 2 • Respiration



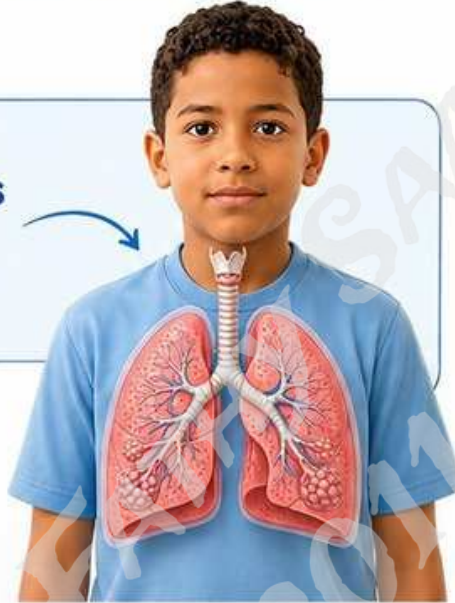
BIG QUESTION

Where in our body does the air we take in get exchanged?



SHORT ANSWER

The air we take in gets exchanged in tiny air sacs in our lungs called **alveoli**.



How does air move around inside our body?

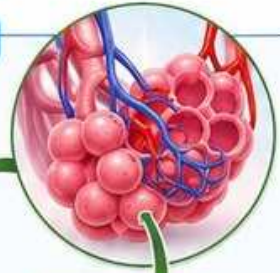
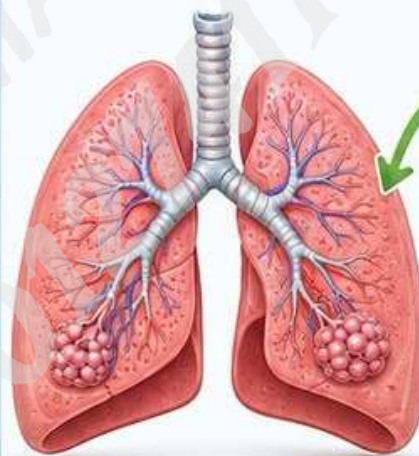


OUR AMAZING LUNGS

- We breathe in air through our **nose** or **mouth**.
- The air goes down the **trachea** (windpipe).
- It travels through the **bronchi** into our lungs.
- Inside the lungs are millions of tiny air sacs called **alveoli**.

★ These alveoli are the place where **oxygen** and **carbon dioxide** are exchanged with our blood.

WHERE DOES EXCHANGE HAPPEN?



ALVEOLI

Tiny air sacs where **oxygen** from the air moves into the blood, and **carbon dioxide** from the blood moves out to be breathed out.



HOW GAS EXCHANGE WORKS

When we breathe in

Air with **oxygen** enters the lungs.



In the alveoli



When we breathe out

Air with **carbon dioxide** leaves the lungs.



KEY POINTS

- ✓ We need **oxygen** to live.
- ✓ Lungs help us get oxygen and remove **carbon dioxide**.
- ✓ Healthy lungs keep our body strong!



2-2 How Lungs Work

Respiration



Chapter 2



Point!

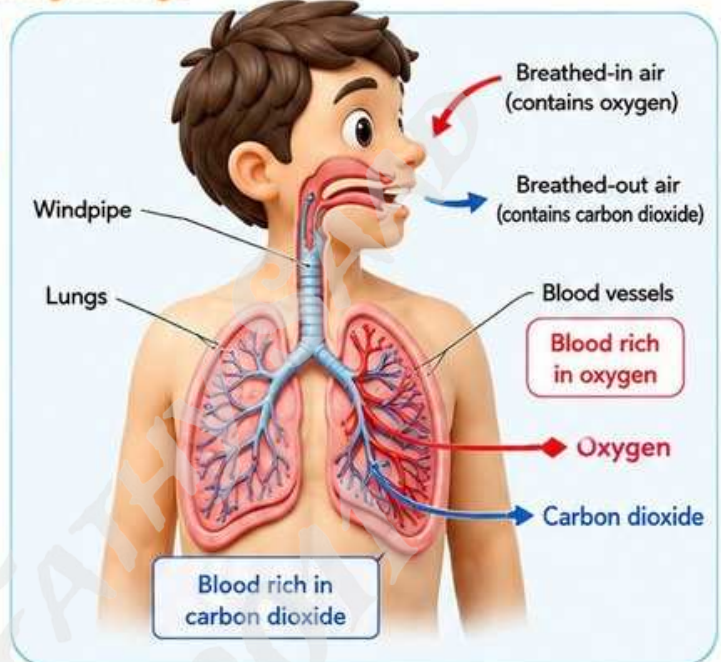
The Place for Gas Exchange: Lungs

The air breathed in from the nose and mouth goes through the windpipe and is sent to the left and right **lungs** in our chest.



Gas exchange

- Through the **blood vessels** around the lungs, **oxygen** in the air is taken into the blood, and **carbon dioxide** in the blood is let out into the air.
- The oxygen taken into the blood is carried to the **whole body** by the work of the heart.
- Air with a lot of **carbon dioxide** goes through the windpipe and is breathed out from the nose and mouth.



Warm Up

Let's understand how the lungs move!

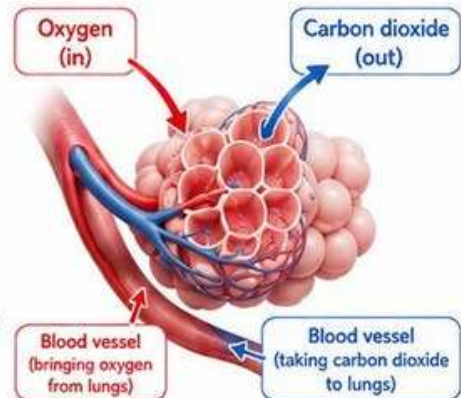
1 Check where the lungs are:

Put your hand on your chest and see how your chest moves when you breathe in.



2 Look at the model picture:

- Look at the zoomed-in picture of the alveoli and see where oxygen and carbon dioxide are exchanged.
- Imagine how the oxygen taken in by the lungs travels through the blood and is carried to your fingertips and toes.



3 Learn about other animals:

Let's learn about how other animals breathe.



Mammals (e.g., dog)

- Breathe in oxygen through the nose.
- Breathe out carbon dioxide.



Fish

- Take in oxygen from water through their gills.
- Let out carbon dioxide through their gills.

Fish let out carbon dioxide from their gills.



Key Facts

- ✓ **Oxygen** from the air goes into the blood in the lungs.
- ✓ **Carbon dioxide** in the blood is sent out to be breathed out.
- ✓ The heart carries oxygen to the **whole body**.



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Chapter 2

Respiration

2-2 How Lungs Work



Try



- 1 What gas do we take into our body when we breathe in?

.....



- 2 When comparing the air we breathe in and the air we breathe out, which gas increases in the air we breathe out? Choose the correct answer.

A Oxygen

B Carbon dioxide

C Neither increases

2

- 1 What is the organ in our chest called that exchanges oxygen and carbon dioxide?

.....



Lungs

The lungs help us breathe.

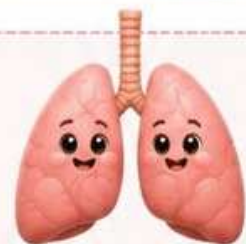
- 2 Fill in the blanks with the correct words to complete the sentence.

Through the (① _____) around the lungs,
(② _____) in the air is taken into the blood,
and (③ _____) in the blood is let out into the air.



Key Idea

- We take in **oxygen** when we breathe in.
- We let out **carbon dioxide** when we breathe out.
- The **lungs** are the organ that exchanges these gases.





2-2 How Lungs Work



Let's test what you know!



EXERCISE

- 1 (1) What happens to **limewater** when you blow breathed-out air into it?

Choose the correct answer from below.

- A It turns milky white.
- B It turns blue.
- C It disappears.



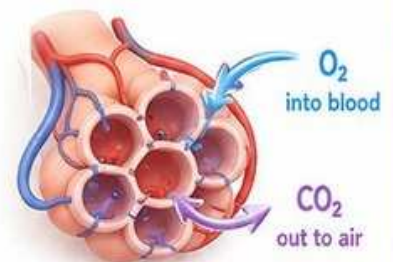
- (2) Which statements correctly explain **breathing**?
Choose **all** correct answers from below.

- A The air we breathe out has no oxygen at all.
- B The air we breathe out also has oxygen.
- C The air we breathe out has more oxygen than the air we breathe in.
- D The air we breathe out has more carbon dioxide than the air we breathe in.



- 2 (1) Which statement correctly explains **gas exchange** in the lungs?
Choose the correct answer from below.

- A It lets out oxygen from the blood into the air.
- B It takes in oxygen from the air into the blood.
- C It takes in carbon dioxide from the air into the blood.



- (2) What carries the oxygen taken in by the lungs to the whole body?
Choose the correct answer from below.

- A Blood
- B Muscles
- C Bones



Blood carries oxygen to every part of the body!



Key Idea

We breathe in **oxygen** and breathe out **carbon dioxide**.



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Where Food Goes

Chapter 3 • Digestion



BIG QUESTION

What happens to the food we eat from our mouth, where does it pass through, and how does it change its shape?



SHORT ANSWER

Food is first broken down into **small pieces** in the mouth. Then it travels through many parts of our body where it is **changed** and used for **energy** and **growth**.



THE JOURNEY OF FOOD

1



Mouth – We **chew** the food with our teeth. It mixes with **saliva** and becomes smaller.

2



Esophagus – We **swallow** the food. It moves down a tube to the stomach.

3



Stomach – Food is mixed with strong juices. It turns into a soft liquid called **chyme**.

4



Small Intestine – Most **nutrients** are absorbed from the chyme into the blood.

5



Large Intestine – Water is removed. What is left becomes **waste**.

6



Rectum & Anus – Waste is stored and then **leaves** the body.

WHERE DOES FOOD PASS?



HOW FOOD CHANGES ITS SHAPE

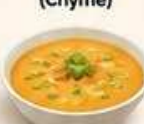
Big pieces of food



Chewed into small pieces



Mixed into soft liquid (Chyme)



Nutrients absorbed



KEY POINTS

- ✓ Digestion changes food so our body can use it.
- ✓ Nutrients give us **energy** and help us **grow**.
- ✓ Drink **water** and eat **healthy food** to help your digestion!



Food is first broken down into small pieces in the mouth! Where does it go after that?



DID YOU KNOW?

Your **stomach** can stretch to hold as much as **1.5 liters** of food!



Point!

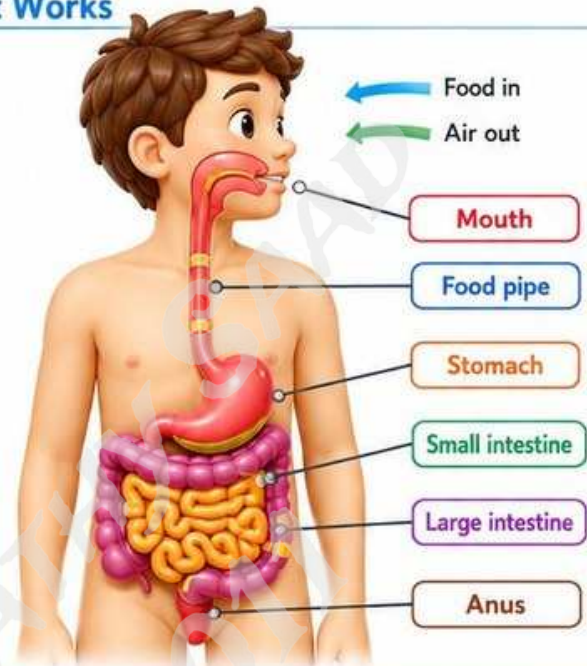
Digestion and How it Works

! Breaking down food with teeth and changing it into a form that is easy to absorb is called **digestion**.

! Food that enters from the mouth is carried in this order:

Mouth → **Food pipe** → **Stomach** → **Small intestine** → **Large intestine**
and comes out from the anus.

The path of food from the mouth to the anus is called the **digestive tract**. ✨



Warm Up

Let's trace the route of digestion!

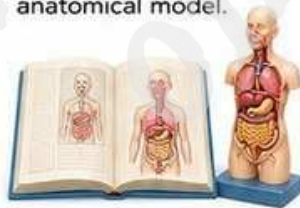
1 Check the route:

Write down the names of the organs the food passes through in order, from the mouth to the anus.



2 Position of internal organs:

Check the positions of the stomach and intestines using a picture book or an anatomical model.



3 Check with your own body:

Press your hands on your body to see where your stomach and intestines are located.



4 Discovery:

Let's find out what the digestive tracts of other animals look like.



Animals Have Different Digestive Tracts!

Mammal (e.g., dog)



- Food passes through a long digestive tract.
- Nutrients are absorbed in the small intestine.

Fish



- Food passes through a shorter digestive tract.
- Nutrients are absorbed in the intestine.



Key Facts

- ✓ **Digestion** breaks down food into a form the body can use.
- ✓ Food travels through these organs: **Mouth** → **Food pipe** → **Stomach** → **Small intestine** → **Large intestine** → **Anus**.
- ✓ Different animals have different digestive tracts.



The Function of Saliva

Digestion



Q What kind of function does the **saliva** in the mouth have?

When you chew rice or bread, it starts to taste **sweet**!
I wonder if it has something to do with the function of **saliva**.



What is saliva?

Saliva is a clear liquid made in the mouth by **salivary glands**.



Where is it made?

It is made by three pairs of **salivary glands** in our mouth.



Functions of saliva

1. Helps food become **soft** and **easy to chew**.
2. Contains an **enzyme** that changes **starch** in food into **sugar**. That's why food starts to taste **sweet**!
3. Helps us **swallow** food easily.



Why is it important?



Keeps the mouth moist and **clean**.



Helps **protect** us from germs.



Helps **digestion** start in the mouth.



Key Idea

Saliva helps us **chew**, **taste**, **swallow**, and start the process of **digestion**.





3-2 The Function of Saliva



Saliva is amazing!



Key Point!

- ★ Saliva in the mouth breaks down **starch** in food.
Starch in food is changed into something else by saliva.
- ☆ A liquid that helps digest food, like saliva, is called a **digestive juice**.
Digestive juices are produced not only in the mouth, but also in the stomach and intestines.



Warm Up

Let's see if saliva changes starch!

1 What do we need?

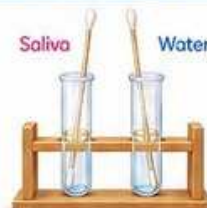


2 Let's Do the Experiment!

- Put the dilute starch solution into two test tubes with a dropper.



- Put a cotton swab soaked with saliva into one test tube. Put a cotton swab soaked with water into the other test tube.



- Put hot water of about 40°C in a beaker, and put the two test tubes in it for a few minutes.



- Add 1 or 2 drops of dilute iodine solution to the warmed test tubes and compare the color changes.



3 Summary

From the results of the experiment, we can confirm that the starch is broken down due to the function of saliva.

What will happen?



Saliva

The color stays yellow or light brown.



Water

The color turns blue or dark purple.



Amazing Science!

We put the test tubes in hot water (~40°C) to keep the **same environment** as inside the body!



Watermarkly



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Try

1

- (1) What do we call the process of changing food into a form that is easy to absorb into the body?



- (2) Choose the correct words from below to fill in the blanks.

Food that enters from the mouth is carried in the order of Mouth → (①) → (②) → (③) → (④), and comes out from the anus.

Large intestine

Stomach

Food pipe

Lungs

Small intestine

2

- (1) What do we call a liquid contained in the body, like saliva, that breaks down food?



- (2) Which statements correctly explain the results of the saliva experiment? Choose all correct answers.



- A** The one mixed with water and starch changed to blue-black with the iodine solution. ☐
- B** The one mixed with water and starch had no change even when the iodine solution was dropped. ☐
- C** The one mixed with saliva and starch changed to blue-black with the iodine solution. ☐
- D** The one mixed with saliva and starch had no change even when the iodine solution was dropped. ☐





Exercise



1 (1) What is the correct order that food passes through?

Choose the correct answer from below.

- A** Mouth → Stomach → Food pipe → Small intestine → Large intestine
- B** Mouth → Food pipe → Stomach → Large intestine → Small intestine
- C** Mouth → Food pipe → Stomach → Small intestine → Large intestine
- D** Mouth → Food pipe → Large intestine → Small intestine → Stomach



2 (2) What is the path of food from the mouth to the anus called?



2 (1) In the experiment to check the function of saliva, why do you warm the test tubes in hot water of about 40 degrees Celsius?

Choose the correct answer from below.



- A** To disinfect.
- B** To evaporate the water.
- C** To make it about the same temperature as inside the body.



(2) After mixing saliva and starch and warming it, did the color change when you added the iodine solution?

Choose the correct answer from below.

It turned blue-black.



It did not change.



Science Tip

Digestion helps the body break down food into tiny pieces so it can get the energy and nutrients it needs.



How Absorption Works

Digestion



Q

Where and how are the **nutrients** from the food that enters the mouth taken into the body?

Maybe there is a secret in the process of passing through the **digestive tract**.



The Journey of Food

1

Mouth



We chew the food. **Saliva** mixes with it and starts breaking it down.

2

Stomach



The food goes to the **stomach**, where it is mixed with strong juices.

3

Small Intestine



Most nutrients are absorbed here into the blood through tiny finger-like structures called **villi**.

4

Blood



The nutrients travel in the **blood** to all parts of the body.

5

Large Intestine



Water is absorbed here. The **waste** is then removed from the body.



Key Idea

Nutrients from food are **absorbed** mainly in the **small intestine** and carried by the **blood** to our body to give us energy and help us grow.





3-3 How absorption works



Tiny bumps, big job!



Key Ideas

- ★ Nutrients from digested food are mainly **absorbed** in the **small intestine** along with water. After that, more water is absorbed in the **large intestine**, and what is left is **eliminated** from the anus as feces.
- ★ A liquid that helps digest food, like saliva, is called a **digestive juice**. Digestive juices are produced not only in the mouth, but also in the stomach and intestines.



The Small Intestine

It has tiny bumps called villi!

Villi are small finger-like bumps on the inside wall of the small intestine. Because they are lined up closely, the inner surface area becomes much larger. This helps **absorb nutrients** and **water** very efficiently.

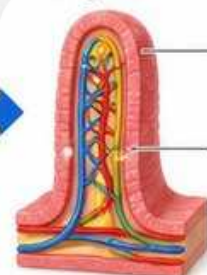
Inside the small intestine



Many villi increase surface area



A villus (enlarged view)



Villi

Capillaries



The nutrients absorbed in the small intestine are carried to the whole body by the **blood**, passing through the **liver**. The liver stores some nutrients and sends them out to the body when needed.



Warm Up

Let's imagine the surface area of the small intestine!

1 Surface of a towel

Look at the surface of a towel. A cloth with many loop-like threads absorbs water better than a flat cloth.



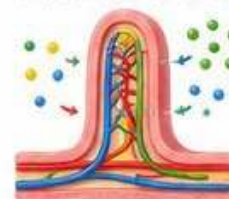
2 Wall of the small intestine

Just like a towel, the wall of the small intestine has bumps (villi), which increases the places to absorb nutrients.



3 Look at the model

Look at the picture and see how nutrients enter the blood vessels from the surface of the villi.



- Nutrients
- Water
- Blood vessel



Summary

Villi greatly **increase the surface area**, so nutrients and water can be absorbed **quickly and efficiently**!

Think!

Why do you think the body needs to absorb nutrients and water quickly?





Try

- 1 (1) What do we call the small bumps on the inner wall of the small intestine that absorb nutrients?



- 2 (2) What carries the absorbed nutrients to the body? Choose the correct answer from below.

A Blood vessels

B Nerves

C Muscles

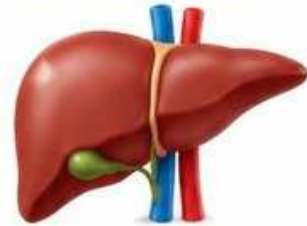


- 3 (3) Where do the nutrients absorbed in the small intestine pass through first to be carried to the whole body? Choose the correct answer from below.

A Stomach

B Large intestine

C Liver



Exercise

- 1 (1) What is the advantage of having villi on the wall of the small intestine? Choose the correct answer from below.

A It makes it easier to swallow food.

B The surface area of the wall of the small intestine becomes larger, and nutrients can be absorbed efficiently.

C It makes it easier for nutrients to pass through.



- 2 (2) Fill in the blanks with the correct words.

The nutrients of digested food, along with water, are mainly absorbed in the (① _____). The nutrients absorbed in the small intestine and carried by the (② _____) through the (③ _____) to the whole body.



Key Fact!

Villi help increase the surface area so more nutrients can be absorbed and carried to all parts of the body.



Let's Expand!

Let's take a closer look at the liver.

Functions of the Liver



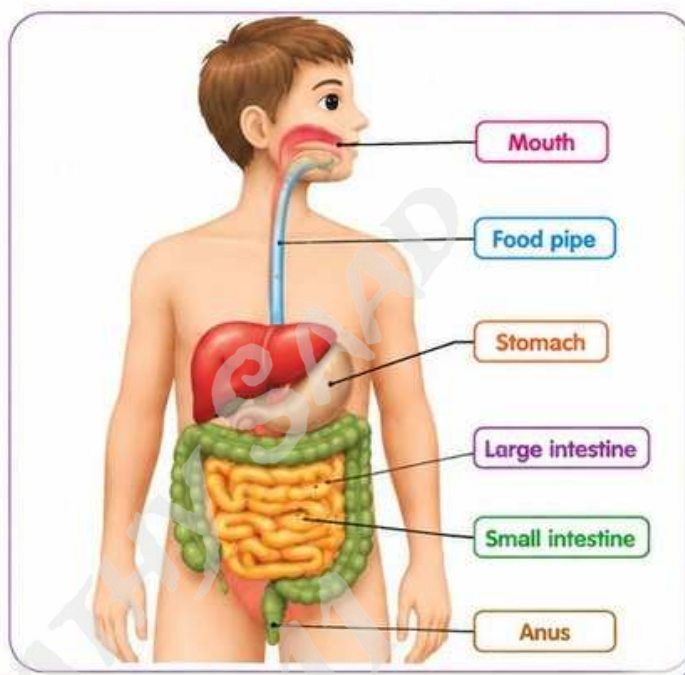
It converts some **nutrients** into a form that is easy for the body to use, **stores** them as energy, and sends them out to the whole body when needed.



It breaks down **harmful substances** produced in the body so they can be eliminated in urine.



It produces a **digestive juice** that helps break down and absorb fat.



Review & Practice

Let's solve the summary questions about digestion.



- 1 What do we call the process of breaking down food into small pieces so that it is easy to take into the body?

- 2 Which is the correct order of the digestive tract that food passes through after entering the mouth? Choose the correct answer below.

A Mouth → Food pipe → Small intestine → Stomach → Large intestine

B Mouth → Stomach → Food pipe → Small intestine → Large intestine

C Mouth → Food pipe → Stomach → Small intestine → Large intestine



Science Tip

The liver is like a hard-working helper! It stores energy, cleans the blood, and makes digestive juice to help our body.



- 3 In the experiment to check the function of saliva, when you mix saliva with starch solution, warm it, and then add iodine solution, does the color change?

It turned blue-black. / It did not change.

☐
☐

- 4 Where are the digested nutrients mainly absorbed into the blood? Choose the correct answer below.

A Food pipe

B Stomach

C Large intestine

D Small intestine

- 5 What do we call the small bumps on the inner wall of the small intestine for absorbing nutrients?

- 6 What do we call a liquid that has the function of breaking down food, like saliva?

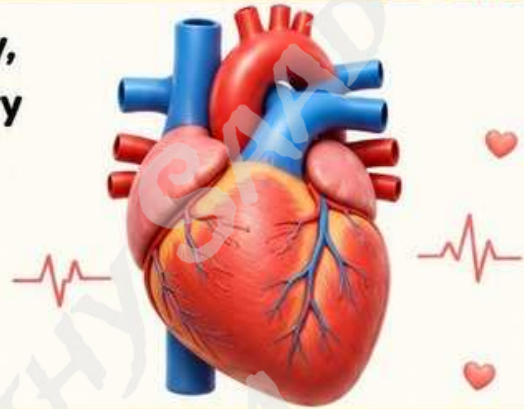
Heart and Blood

★ Circulation and Excretion ★



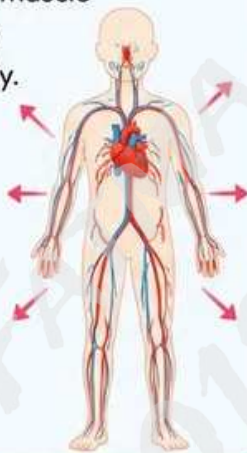
Q What role does the **heart** play, and what does the **blood** carry throughout the body?

When you exercise, your **heart** beats faster. Why is that?



What does the heart do?

- ★ The heart is a strong muscle that **pumps blood** to every part of the body.



What does the blood carry?

- ★ Blood **carries** important things to all parts of the body.



Oxygen

to help us breathe and stay alive.



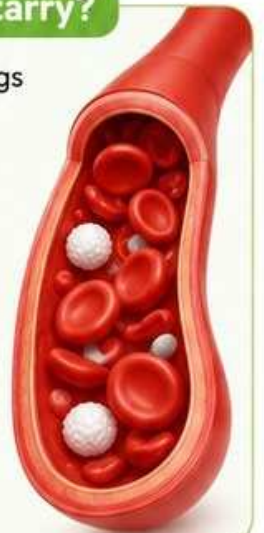
Nutrients

from the food we eat to give us energy.



Waste

to be removed from the body.



How the Heart and Blood Work Together

1

Heart Pumps



The heart pumps blood out.

2

Blood Travels



Blood flows through blood vessels.

3

Delivers



It delivers oxygen and nutrients to every cell.

4

Collects Waste



It collects waste from the cells.

5

Back to Heart



Blood returns to the heart to be pumped again.



Key Idea

The **heart** is like a **pump**.

The **blood** is like a **delivery truck**.

Together, they keep our body healthy and strong!



4-1 Heart and Blood

Circulation and Excretion

Chapter 4



★ Key Points

- ✓ **Nutrients** absorbed from the small intestine and **oxygen** taken in by the lungs are **carried** to the whole body by the **blood**.
The blood is pumped out by the **heart**, travels **throughout the body**, and returns to the heart again.
- ✓ The movement of the heart pumping out blood is called a **heartbeat**.
 - The heartbeat travels through the blood vessels and can be felt as a **pulse** at the wrist.



💡 Did You Know?

Your heart beats about **60-100** times per minute when you are resting!



Blood Circulation

- ➔ Blood flows through **blood vessels** that spread all over the body and circulates inside.
- ➔ The blood pumped out from the **heart** carries **oxygen** and **nutrients** to the whole body, collects **carbon dioxide** and **waste** produced in the body, and returns to the **heart** again.
- ➔ The blood that has returned to the heart is **sent to the lungs** to let out **carbon dioxide** and take in **oxygen**.

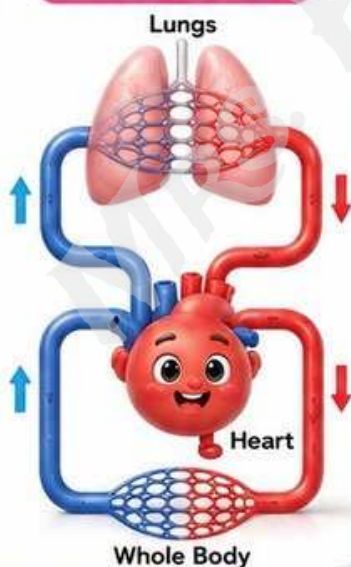
← **Red:**

Blood rich in oxygen

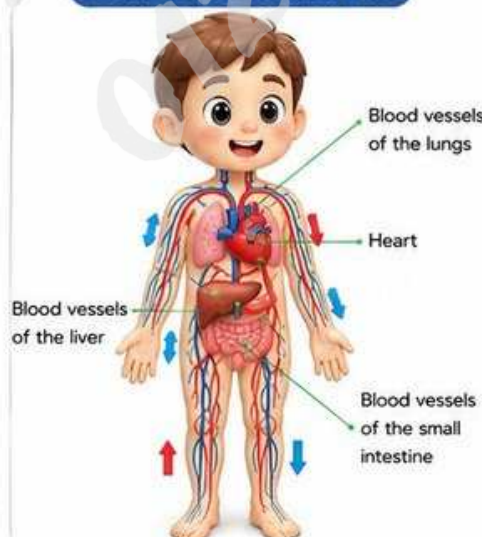
➔ **Blue:**

Blood rich in carbon dioxide

The Path of Blood



Where Blood Vessels Go



What's Happening?



The heart pumps blood rich in **oxygen** to the whole body.



The blood collects **carbon dioxide** and **waste** from cells.



The blood goes to the **lungs** to let out carbon dioxide and take in **oxygen**.

★ Think!



Why do you think the blood needs to travel through the whole body?

The body needs **oxygen** and **nutrients**, and the blood delivers them!



35

Watermarkly



Warm Up

Let's measure your pulse!



Let's check how our pulse changes when we exercise.

1 Preparation

- Stopwatch



2 Experiment

- 1 Put your finger near the base of your thumb on your wrist and find the place where it is beating (throbbing).
- 2 While sitting, count how many times your pulse beats in 1 minute.
- 3 After jumping lightly, measure it again.



3 Compare



Check that the heart beats faster when you exercise, and let's discuss the reason together.

Did you know?



Exercise makes your body need more **oxygen** and **energy**, so your heart beats faster to send blood all around your body!

Good to Know!



You can also feel your pulse by touching your neck or ankle.





Try

1 What is the organ that works like a pump to send blood to the whole body?

2 What are the important things that blood carries to the whole body?

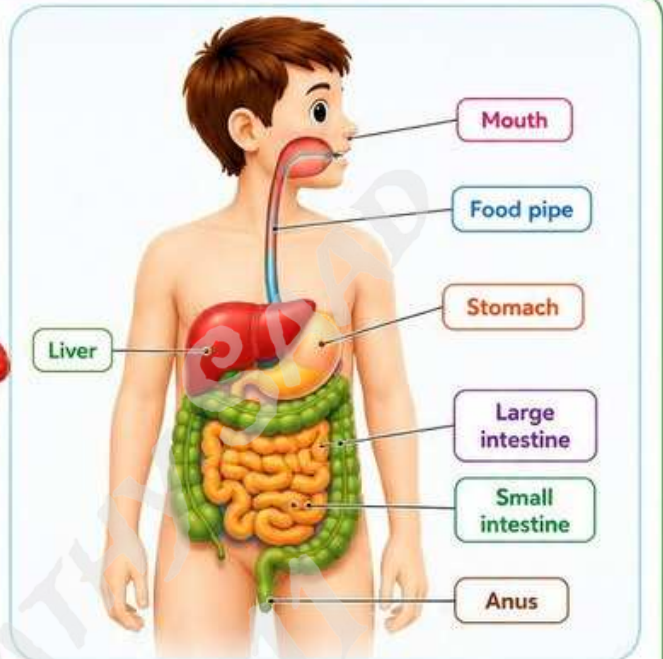
Choose all correct answers.

- A Oxygen
- B Carbon dioxide
- C Nutrients
- D Muscles

3 Why does your pulse become faster after exercising?

Choose the correct answer.

- A To let the blood rest slowly.
- B To carry more oxygen and nutrients to the whole body quickly.
- C Because there are not enough nutrients.



Exercise

1 Which statement correctly explains the heart? Choose the correct answer from below.

- A The heart plays a role in digesting the food we eat.
- B The heart is constantly beating to pump out blood.
- C The heart plays a role in storing nutrients.



2 What do we call the movement of the heart pumping out blood?



What do we call the small bumps on the inner wall of the small intestine for absorbing nutrients?

3 Fill in the blanks with the correct words.

oxygen

carbon dioxide

lungs

The blood pumped out from the heart carries (① _____) and nutrients to the whole body, collects (② _____) and waste produced in the body, and returns to the heart again.

The blood that has returned to the heart is sent to the (③ _____) to exchange (① _____) and (② _____).

4 Where are the digested nutrients mainly absorbed into the blood? Choose the correct answer from below.

- A Food pipe
- B Stomach
- C Large intestine
- D Small intestine

6 What do we call a liquid that has the function of breaking down food, like saliva?



Quick Fact!

The **heart** is a strong **pump**. It keeps blood moving to give our body the things it needs to stay healthy!



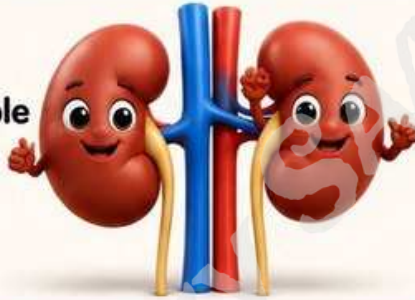
How the Kidneys Work

★ Circulation and Excretion ★



Q

How are the “**unnecessary things**” collected from the whole body taken out of the body?



How does the system work to take only the unnecessary things out of the body?

?

1 What Do the Kidneys Do?

- ★ The kidneys are **two bean-shaped organs** in your body.
- ★ They clean the blood by removing **waste** and **extra water**.



2 How the Kidneys Make Urine

The kidneys **filter the blood** in steps:

1

Filter



Waste and extra water are filtered out of the blood.

2

Reabsorb



Helpful things like water and nutrients go back into the blood.

3

Make Urine



The remaining waste and extra water become urine.

4

Urine Leaves



Urine travels through tubes to the bladder and leaves the body.

3 The Journey of Waste Out of the Body



Unnecessary things are in the blood.



Kidneys clean the blood.



Waste becomes urine.



Urine is stored in the bladder.



Urine leaves the body when we go to the bathroom.



Key Idea

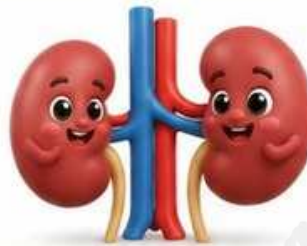
- Kidneys remove **waste** and **extra water** from the blood.
- They make **urine**.
- This keeps our body **clean** and **healthy**!



4-2 How the Kidneys Work

★ Key Points

- ✓ Waste products (unnecessary things produced in the body) are carried to the **kidneys** by the **blood**. There are **two kidneys** on the lower back.



- ✓ In the kidneys, waste products produced in the body and extra water are filtered out from the blood to become **urine**.
The urine is temporarily stored in the **bladder**, and then discharged out of the body.

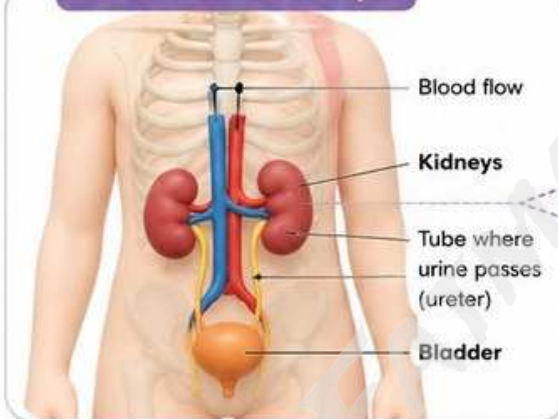


💡 Did You Know?

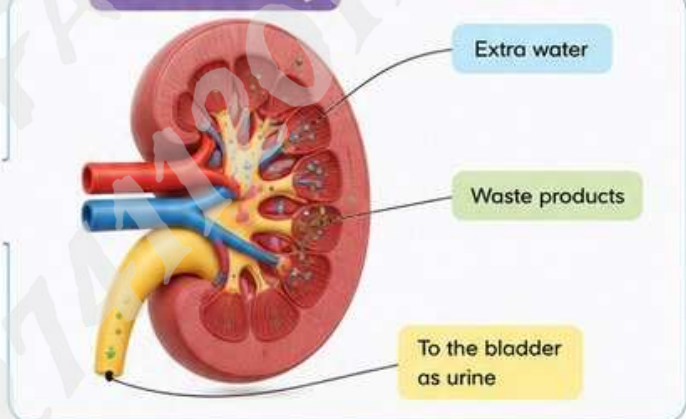
Your kidneys work all the time to keep your body clean by removing waste!



Where Are the Kidneys?



Inside a Kidney



🔍 Warm Up Let's trace the body's cleaning route!

Look at the diagram and check the order of how the waste products in the body are eliminated.

1 Filter out

Imagine how the blood enters the kidneys and is filtered there.



2 Store

Check the place where urine (the liquid containing waste products) is temporarily stored in the bladder.



3 Out of the body

Let's learn that the inside of the body is kept clean by discharging urine.



Out it goes!
Nice and clean!

★ Key Takeaway

The kidneys filter waste and extra water from the blood to make urine. The urine is stored in the **bladder** and then leaves the body.





Where are the organs we have learned so far located in the body, and how are they connected?

We have learned about various organs so far.



Let's review them together!

Our Important Organs

Brain

Controls our body and helps us think.



Lungs

Help us breathe in air and get oxygen.



Liver

Cleans the blood and helps digest food.



Heart

Pumps blood to all parts of the body.



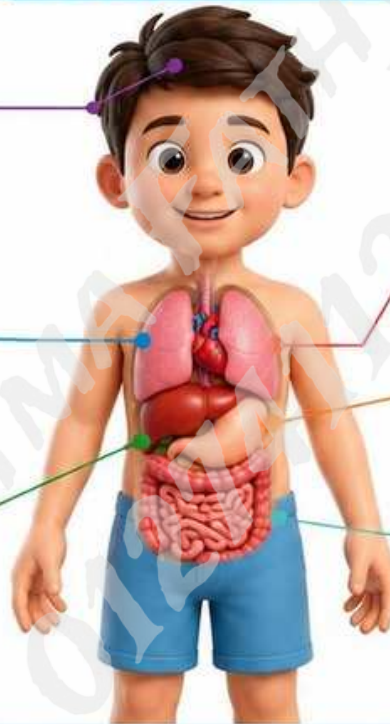
Stomach

Stores food and starts breaking it down.



Intestines

Absorb nutrients and remove waste.



How They Work Together

These organs work together to keep our body healthy:

Breathe → Get Oxygen → Heart Pumps Blood → Nutrients Reach the Body → Waste Removed



Key Fact

Many organs are connected through **blood vessels**. They help transport blood, oxygen, and nutrients to every part of the body!





POINT!

Arrangement and Teamwork of Organs



1 Organs work together

In our body, many organs are lined up closely without gaps, and they work together each other.



2 Organs in the chest

There are left and right lungs, and the heart sandwiched between them. They are protected by the ribs.



3 Organs in the abdomen

There is the stomach at the top, the long small intestine below it, and the large intestine around it.



4 Organs in the lower back

There is one kidney on each side.

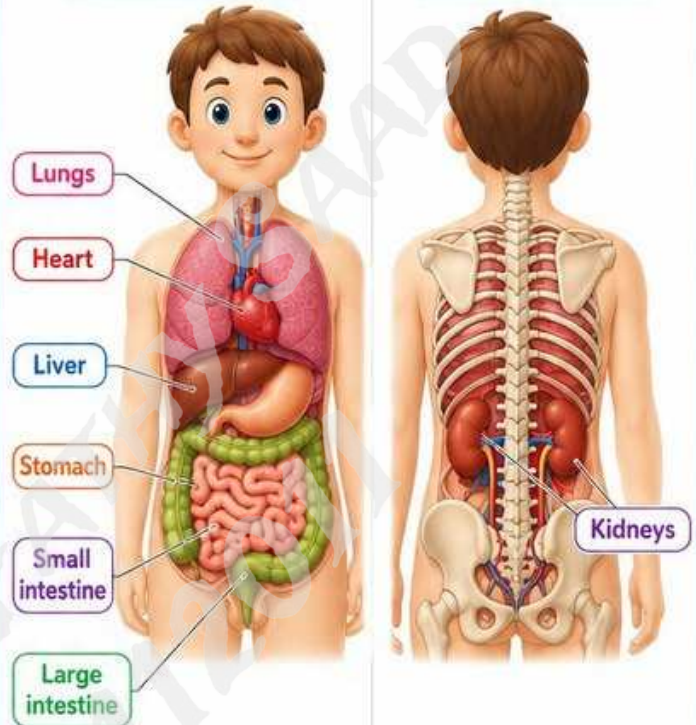


5 All organs are connected

All organs are connected by blood vessels. The blood carries nutrients and oxygen to the body and collects waste products.

Front of the body

Back of the body



WARM UP

Let's check the locations of the organs!

While looking at the illustration above, let's check the places from the top of your body.

1 In order from the top:

Let's check the positions of organs such as the lungs, heart, and stomach.



2 Think about the overlapping:

The heart and lungs are located higher than the stomach. Let's check that they are protected by the ribs.



WOW
FACT!

Your body is like a team!

Each organ has a special job, and they all work together to keep you healthy and strong!



Try & Learn!

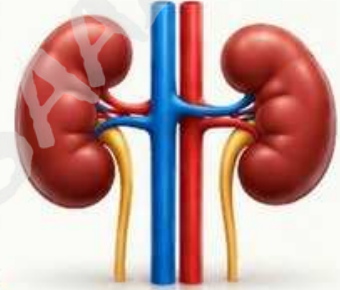


1

- 1 What is the organ called that filters the blood and filters out waste products?
- _____

- 2 What is the liquid waste produced in (1) called?
- _____

- 3 How many of (1) are there in the body?
- _____



Key Words

kidneys • waste • urine

2

- (1) Choose 2 organs that are **inside the chest** of the human body.

A Stomach



B Heart



C Lungs



D Large intestine



E Small intestine



Think: Which organs protect us in the chest?

2

- (2) Among the following organs, which one has **one on each side** of the body, for a total of two? Choose the correct answer from below.

A Lungs



B Stomach



C Heart



D Small intestine



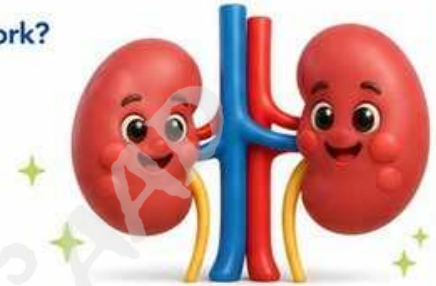
Think: Which organ comes in a pair?



EXERCISE

- 1 (1) Which statement correctly explains how the kidneys work?
Choose the correct answer from below.

- A It absorbs oxygen from the blood.
- B It pumps blood to the whole body.
- C It takes out waste products from the blood.



- 2 (2) Where is the urine produced in the kidneys temporarily stored until it is discharged out of the body?



- 2 (1) Which statement correctly describes where the organs are located?
Choose the correct answer from below.



- A The small intestine is outside the large intestine and surrounds the large intestine.
- B The stomach is connected to the food pipe.
- C The stomach is on the lower side of the abdomen.
- D There are two kidneys on the abdomen side.



- (2) Fill in the blank with the correct word.

Each organ is not moving separately, but all are connected by (_____) and work together.



LET'S THINK!

Look at the steps below to understand how the kidneys help clean our body.

1 Filter out

The blood enters the kidneys and waste products and extra water are filtered out.



2 Store

The urine (liquid waste) is temporarily stored in the bladder.



3 Out of the body

The urine is discharged out of the body to keep us clean.



KEY TAKEAWAY

The kidneys remove waste and extra water from the blood to make urine. The urine is stored in the bladder and then leaves the body.





1 What Mummies Taught Us About the Locations of Our Organs

In Chapters 2 through 4, we learned how the **lungs**, **stomach**, **heart**, and **kidneys** work. In fact, ancient Egyptians were the first people in the world to know the exact locations and shapes of these organs, thanks to their mummy-making skills!



The Secret of Canopic Jars

When ancient Egyptians made mummies, they kept four very important organs — the lungs, stomach, liver, and intestines — safe in special jars. They knew that these were important “engines” that supported human life.



The Heart is the “Place of Wisdom”

As we learned in Chapter 4, the heart is a pump that sends blood throughout the body. However, ancient people believed the heart was where the “mind” (or soul) resided, so they left it inside the body.



The heart pumps blood to keep us alive!

2

Canopic Jars

Imsety

Has a human shape and was believed to be the god who protects the **liver**.



Hapi

Has a baboon shape and was believed to be the god who protects the **lungs**.



Duamutef

Has a jackal (wild dog) shape and was believed to be the god who protects the **stomach**.



Qebehsenuef

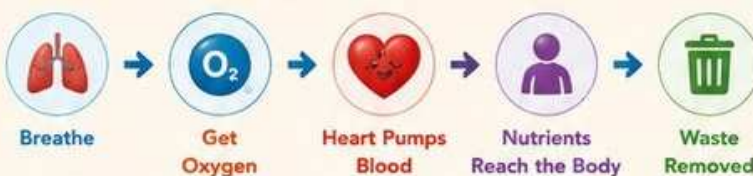
Has a falcon shape and was believed to be the god who protects the **intestines**.



3

How They Work Together

These organs work together to keep our body healthy!



Key Fact!

Many organs are connected through **blood vessels**. They help transport blood, oxygen, and nutrients to every part of the body!



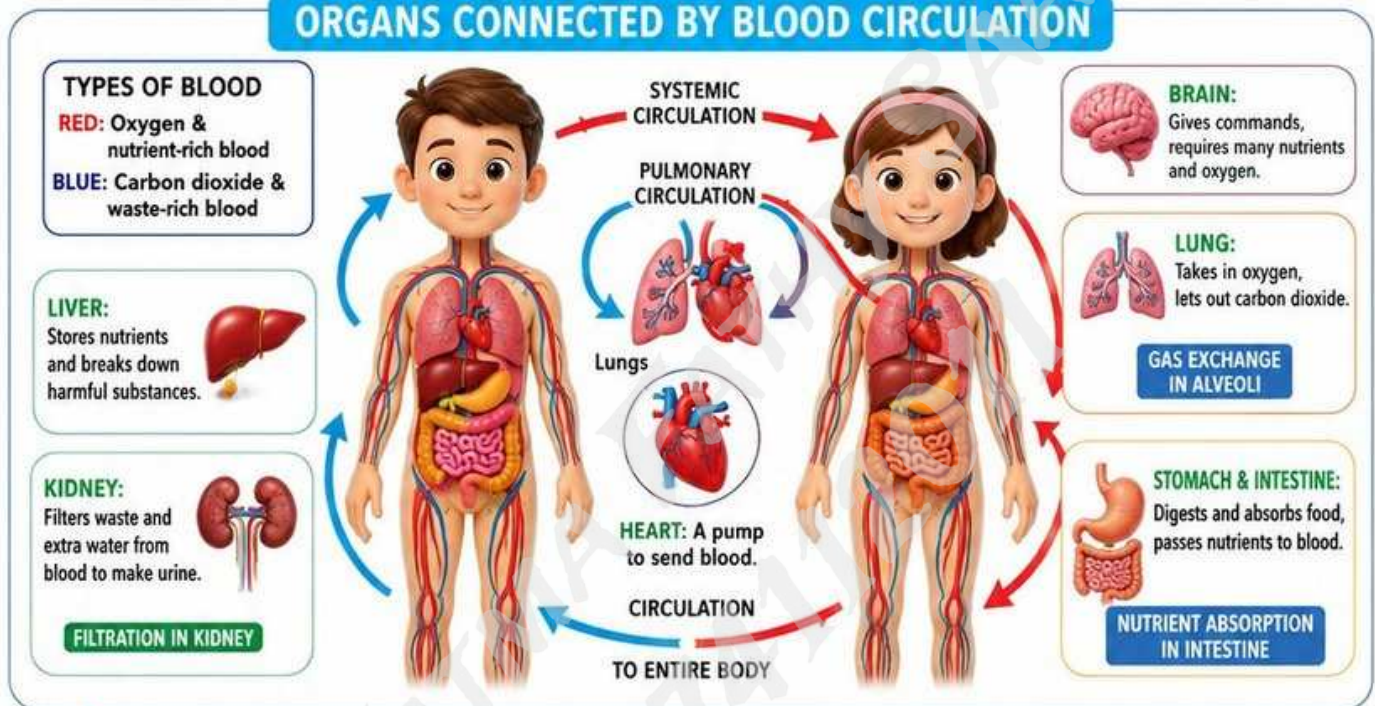
2 Keeping Our Body's Organs Healthy



In modern science, we learn that our organs do not work separately. They are all **connected** together by the circulation of blood.



ORGANS CONNECTED BY BLOOD CIRCULATION



The Transporters of Oxygen and Nutrients

The **oxygen** we breathe in through our lungs and the **nutrients** we absorb from our small intestine are all carried to cells all over our body by the **blood**, using the pumping power of the **heart**.



Egyptian Food for Good Health

Our bodies are made from the food we eat. A traditional Egyptian food called "**Molokhia**" is full of **nutrients** that help keep our **blood** flowing smoothly and help us digest our food. Learning how our body works helps us understand why taking care of our daily meals is so important.



Inside our bodies, the **heart** works without resting to pump **blood** and deliver **oxygen** and **nutrients** from our food to every corner of our body!



Chapter 5

Sunlight and Starch

Photosynthesis



Q What is made when sunlight hits the leaves of plants?

Answer

When sunlight hits the leaves of plants, the plant makes food.

The food is called **starch**.



★ How Does It Happen? ★

1

Sunlight shines on the leaves.



2

The leaves use sunlight.



3

The plant makes its food.



4

The food is stored as starch.



None of the leaves are **overlapping**.



Key Idea

Plants need **sunlight** to make their food (**starch**) in the leaves.

I wonder if they all need **sunlight**.



5-1 Sunlight and Starch

Key Ideas

Plants and Nutrients



- ✓ When sunlight hits the leaves of plants, the **starch** they need to grow is produced.

! How to check if sunlight is needed to produce starch

- Condition to change: **Whether the leaf gets sunlight or not.**
- Since there might already be starch in the leaves, cover the leaves from the day before the experiment so that sunlight does not hit them.

! Reaction with iodine solution

When you add **iodine solution** to starch, the color changes to **blue-black**.



How to check for starch in leaves

- 1 Put the leaf in hot water to make it soft.

! Caution!

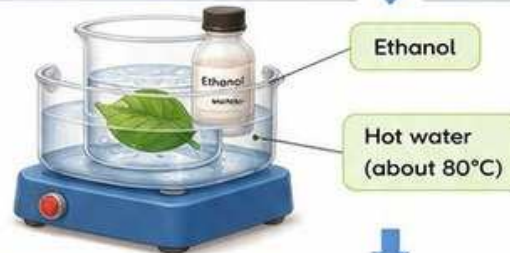
- Do not touch the hot water directly, or you will get burned.



- 2 Put the leaf from 1 into ethanol warmed in hot water. (To remove the green color from the leaf)

! Caution!

- Ethanol is highly flammable, so do not heat it directly over a flame.



- 3 Wash the leaf from 2 with hot water, and soak it in dilute iodine solution.



Did You Know?

Plants make starch from sunlight, water, and carbon dioxide. This process is called **photosynthesis**!



Key Takeaway

Sunlight helps plants make starch, which gives them energy to grow. We can test for starch in leaves using hot water, ethanol, and iodine solution. Iodine turns blue-black when starch is present.





Warm Up

Let's check how leaves produce nutrients!

Let's check the relationship between sunlight and starch in leaves.

1 Preparation



Plant



Aluminum foil



Dilute iodine solution



Ethanol



Beaker



Petri dish



Hot water
(about 80°C)

2 The day before the experiment

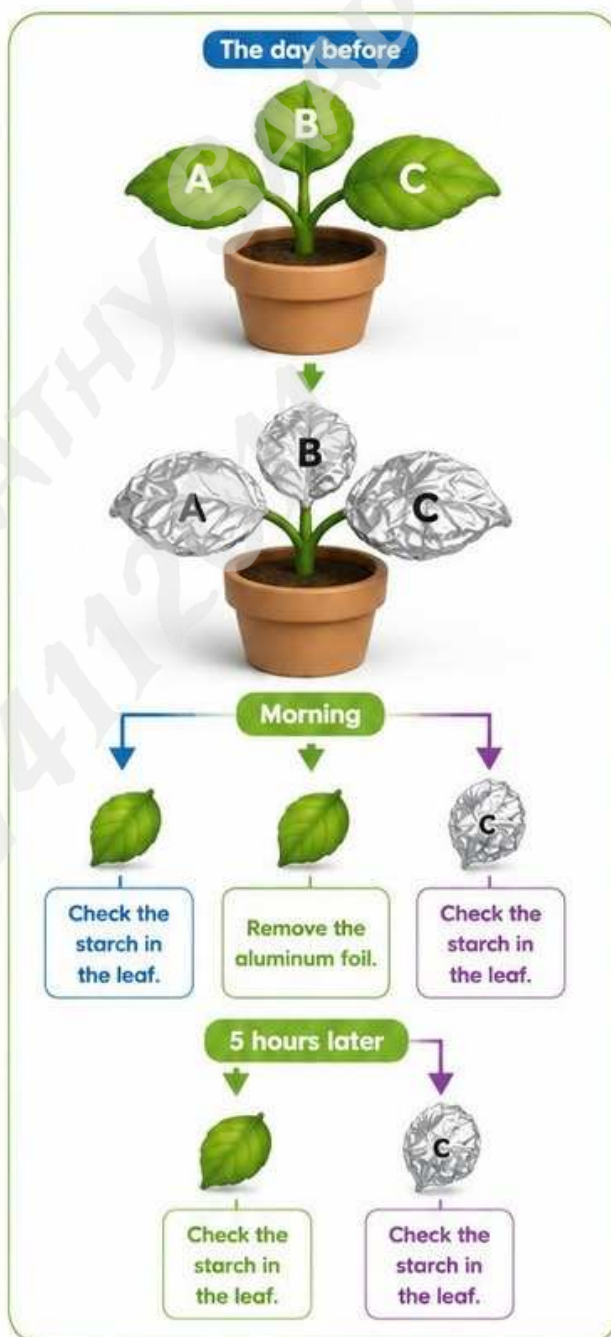
- Make small cuts in each leaf so you can tell **A**, **B**, and **C** apart.
- Cover the plant's leaves with aluminum foil so they do not receive sunlight.

3 Morning of the experiment day

- Remove the aluminum foil from **B**.
- Take leaf **A** and check if there is any starch.

4 5 hours later

- Take leaves **B** and **C** and check if there is any starch.



Let's expose **B** to sunlight for **5 hours** after taking off the aluminum foil.

What will we learn?

We will discover that leaves need sunlight to make starch, which is a kind of food for the plant!



5-1 Sunlight and Starch

Photosynthesis

Chapter 5

Try

- 1 What nutrient is produced when sunlight hits the leaves of plants?



- 2 What color does a leaf that was in the sunlight turn when soaked in iodine solution? Choose the correct answer from below.

- A Does not change
- B Red
- C Blue-black
- D Yellow



- 3 In the experiment to check if sunlight is needed to produce starch, what is the condition you change?



Exercise

- 1 If you hide a part of a leaf with aluminum foil to block the sunlight, how will that part react to the iodine solution reaction?

Covered with aluminum foil



- 2 Which of the following explanations is correct? Choose the correct answer from below.

- A Plants produce starch by receiving sunlight.
- B Plants produce starch by blocking sunlight.



Plants make their own food (starch) using sunlight!



Science Tip

Sunlight is very important for plants because it helps them make **starch**, which is food for the plant!



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Watermarkly

Chapter 5

Gas Exchange

Photosynthesis



Q How do plants exchange gas with the air?

Plants use tiny openings called **stomata** on their leaves to exchange gases with the air.



Stomata

Tiny openings on leaves that let gases in and out.

What Happens?



Daytime (with sunlight)

- Plants take in carbon dioxide (CO_2) from the air.
- They release oxygen (O_2).
- They make food (sugar) in the leaves by photosynthesis.



Nighttime (without sunlight)

- Plants take in oxygen (O_2) from the air.
- They release carbon dioxide (CO_2).
- No food is made at night.



Gas Exchange Summary

Time	Gas Taken In	Gas Released	Food Made?
Daytime	Carbon dioxide (CO_2)	Oxygen (O_2)	Yes
Nighttime	Oxygen (O_2)	Carbon dioxide (CO_2)	No



Is there a difference between daytime with **sunlight** and nighttime **without sunlight**?



Key Idea

Plants exchange gases with the air through tiny openings called **stomata**.



5-2 Gas Exchange

Photosynthesis

Chapter 5



Key Ideas

- ✓ When sunlight hits the leaves, plants take in **carbon dioxide** and release **oxygen**.



- ✓ Plants also breathe to live and stay active. In breathing, they take in **oxygen** and release **carbon dioxide**.



Day and Night



Daytime (with light)

Because there is light, taking in **carbon dioxide** and releasing **oxygen** is very active.

- ✓ Breathing is also happening, but overall, they take in more carbon dioxide.



Nighttime (without light)

Because there is no light, they only breathe, taking in **oxygen** and releasing **carbon dioxide**.



Warm Up

Let's measure the gas inside the bag!

Let's predict how the air will change after a while when a plant is wrapped in a bag.



Plant



Polyethylene bag



Straw



Twist tie



Gas detector tube for oxygen



Gas detector tube for carbon dioxide



Gas sampling pump



Scissors



How to Do It

- 1 On a sunny day, put a bag over the plant, tie the base with a twist tie, and breathe into it.



- 2 Make a small hole in the bag with scissors, and use the gas detector tube to check the percentage of oxygen and carbon dioxide inside the bag.



- 3 Leave it in a place with sunlight for about 1 hour.



- 4 Let's use the gas detector tube to check how the percentage of carbon dioxide and oxygen has changed.



Summary

Let's summarize the percentages of carbon dioxide and oxygen we checked in 2 and 4. Let's talk about how the air changed.



Plants and air help each other! Let's keep our air clean!





Try It!



- 1 What gas do plants release into the air when they are in the sunlight?



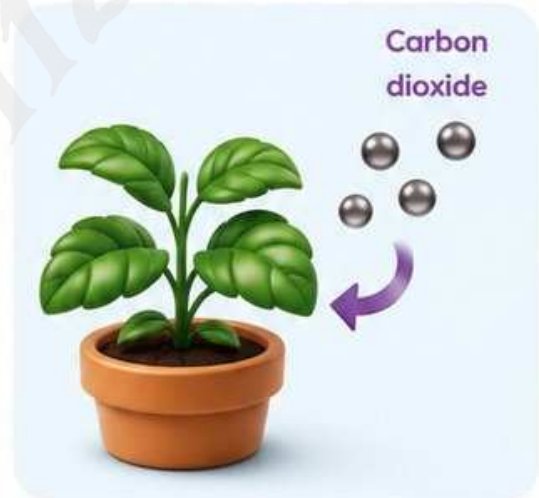


- 2 What gas do plants take in from the air when they breathe? Choose the correct answer from below.

A Oxygen

B Carbon dioxide

C Nitrogen



Did You Know?

Plants exchange gases!

They take in **carbon dioxide** and release **oxygen**.



Sunlight helps plants make food and release oxygen for us!





Exercise

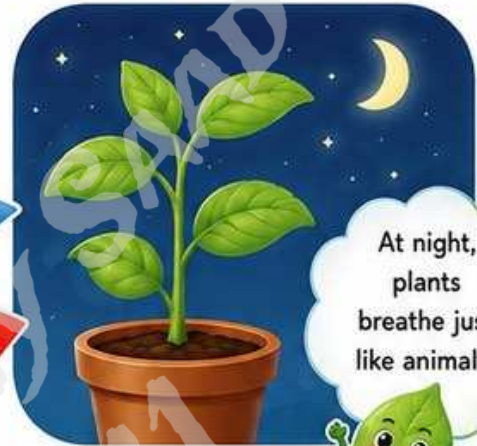


- 1** During the night, when there is no light, what kind of gas exchange do plants do?
Choose the correct answer from below.

- A** Take in oxygen and release carbon dioxide (breathing).
B Take in carbon dioxide and release oxygen.

O_2
Oxygen

CO_2
Carbon dioxide



- 2** Which statement correctly explains plants and air?
Choose the correct answer from below.

- A** Plants keep releasing only oxygen all day long.
B During the daytime, they take in more carbon dioxide than the carbon dioxide they release by breathing.
C While the sunlight is hitting them, plants do not breathe.



CO_2



O_2



Plants breathe all the time — day and night!



Key Point

Plants take in **carbon dioxide** and release **oxygen** during the daytime.
At night, they take in **oxygen** and release **carbon dioxide**.



Transpiration

Transportation of Water in Plants



Where does the water that plants absorb from their roots go?



The inside of the bag is cloudy, and it has water drops on it! Is there an exit for the water somewhere?



The Journey of Water in a Plant

1 Absorbed by Roots

Roots take in water from the soil.



2 Moves Up the Stem

Water travels up through tiny tubes inside the stem called **xylem**.



3 Reaches the Leaves

Water arrives at the leaves.



4 Released to the Air

Water changes to vapor and leaves the plant through tiny openings called **stomata**.



Water in the soil



Stomata

Tiny openings on the leaves that let water vapor out.

What Happens?



Daytime (with sunlight)

- Stomata open.
- More water vapor leaves the plant.
- This helps keep the plant cool.



Nighttime (without sunlight)

- Stomata mostly close.
- Less water vapor leaves the plant.
- The plant saves water.



Key Idea

Water absorbed by the roots travels up the stem and is released into the air from the leaves through **stomata**.



6-1 Transpiration



Key Point!



Some of the water absorbed from the roots goes out into the air from the leaves.

The process of water inside the plant changing into water vapor and being released into the air is called **transpiration**.



Stomata

These are small pores mostly found on the underside of the leaves.

They act as exits for water vapor.

Transpiration mainly happens through the **stomata**.



Did You Know?

- Plants also breathe to live and stay active.
- In breathing, they take in **oxygen** and release **carbon dioxide**.



Day and Night

Daytime (with light)

- Plants take in **carbon dioxide** and release **oxygen** very actively.
- Breathing also happens, but overall they take in more carbon dioxide.



Nighttime (without light)

- Plants only breathe. They take in **oxygen** and release **carbon dioxide**.



Warm Up

Let's find the water drops in the bag!

Let's observe that water is coming out of the leaves.



1 Preparation



- Plants (Plant A with leaves and Plant B with all the leaves taken off)



- Plastic bags



- Twist ties or strings



- Gas detector tube for oxygen



- Gas detector tube for carbon dioxide



- Gas sampling pump



- Scissors

2 Experiment

- On a sunny day, put bags over Plant A (with leaves) and Plant B (with all leaves taken off), and tie the bases with twist ties or strings.
- Leave them in a sunny place for a while.
- Check if water drops form inside the bags. This is the water that transpired from the leaves.



Plant A (with leaves)



Plant B (no leaves)

3 Compare

- Let's check how the inside of the bags is different between A and B.
- Let's talk about what we can learn from this experiment.



What we learn:

Leaves release water vapor into the air through tiny pores called **stomata**.





Let's Think!



?

Where does the **water** absorbed from the **roots** pass through to be carried to the **whole body**?

The plant came back to life after **watering!**
How was the water carried to the **whole body** of the plant?



Key Idea

Water absorbed by the roots travels upward through tiny tubes in the plant called **xylem** to **reach all parts of the plant**.

The Path of Water



1 Roots **absorb** water from the soil.



2 Water moves up through the **xylem** (tiny tubes).



3 The water travels up the **stem**.



4 Water reaches the **leaves** and all parts of the plant.

Remember!

- Water is the **life** of the **plant**.
- Without it, plants cannot grow or stay healthy.



6-2 The Path of Water

Transportation of Water in Plants

Chapter 6



Point!

- If you water the base of a wilted plant, the plant recovers after a while. This is because water spreads to the whole body of the plant.
- There are paths in the roots, stems, and leaves of plants to carry water.

Water is transported in the order of
Roots → Stems → Leaves



- 1 Roots**
Roots absorb water from the soil.
- 2 Stems**
Water travels up through the stems.
- 3 Leaves**
Water reaches the leaves.



Warm Up

Let's observe the path of water!

Let's use colored water to visualize where the water passes through.

1 Preparation:



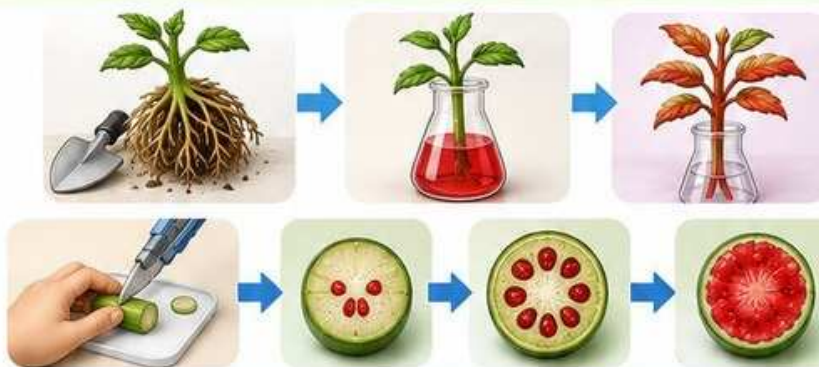
2 Experiment:

- 1 Dig up the plant with the soil, and wash the roots with water.
- 2 Put colored water in the flask and soak the roots in it.
- 3 After a few hours, observe the color change in the plant.
- 4 Cut the roots, stems, and leaves with a cutter knife, and observe the cut surfaces.



3 Summary:

- The parts that turned red are the paths for the colored water.
- Let's sketch and summarize.



The red color shows the water paths inside the plant!



Key Fact

Water absorbed by the **roots** travels up through the **stems** and reaches the **leaves** to help the plant grow and stay healthy.



Transportation of Water in Plants



6-2 The Path of Water

Try It!

1

- (1) What is it called when the water inside a plant changes into water vapor and is released from the leaves?



Water vapor leaving the leaf through **stomata**

2

- (2) In the experiment to check that water comes out of the leaves, what is the reason why water drops formed inside the plastic bag? Choose the correct answer from below.

- A** Because it rained from outside.
- B** Because water vapor came out of the leaves and changed into water.
- C** Because the plant breathed and released carbon dioxide.



2

- (1) Write the order in which the water absorbed from the roots passes through. Fill in the blanks with the correct words.



- (2) What happens after a while when you water the base of a wilted plant?



Science Fact

Transpiration helps cool the plant and pulls more water up from the roots, like a **pump**!



6-2 The Path of Water

Transportation of Water in Plants

Chapter 6



Exercise

- 1 (1) What are the small pores called, which are mostly on the underside of leaves, that act as exits for water vapor?

.....



- (2) Which statement correctly explains transpiration? Choose the correct answer from below.

- A** Transpiration actively happens from the stems, not the leaves.
- B** Transpiration is when plants release oxygen.
- C** Transpiration happens through the **small pores** on the underside of the leaves, which act as exits for water vapor.



- 2 (1) Which statement correctly explains the path of water in plants? Choose the correct answer from below.

- A** Water flows freely everywhere inside the stem.
- B** **Tubes** are connected from the roots to the tips of the leaves to carry water.
- C** The water absorbed from the roots passes through the stems, but does not go to the leaves.



- (2) When a plant is wilted, what should you do to recover it?

.....



Science Tip!

Transpiration is important!

Water absorbed by the roots travels up through tubes in the stem and leaves the plant as water vapor through tiny pores called **stomata**.



Why is transpiration important?

- Helps pull water up from the roots to the leaves.
- Helps cool down the plant.
- Helps plants stay healthy!

Chapter 6 Column

Blessings of the Nile – Plant Survival Strategies

1 The “Green Factory” That Turns Sunlight into Electricity

In Chapters 5 and 6, we learned about **photosynthesis**, where plants use sunlight to produce starch.



Solar Panels on the Water Lotus

- The leaves of the **lotus** (water lily) floating on the Nile River have a flat and large shape.
- This shape helps them catch as much of Egypt's strong **sunlight** as possible.
- So they can produce nutrients (**starch**) efficiently.



Exchanging Gases

- When plants do photosynthesis, they take in the **carbon dioxide** that humans breathe out and release **oxygen**.
- The beautiful green plants along the Nile River act as a “**natural air purifier**” to keep the air in Egypt clear.



Key Facts

- ✓ Lotus leaves are wide and flat to catch more **sunlight**.
- ✓ Plants use **carbon dioxide** and release **oxygen**.
- ✓ Green plants help keep the air clean.



6-2 The Path of Water

Transportation of Water in Plants

Chapter 6



Point!

★ If you water the base of a wilted plant, the plant recovers after a while. This is because water spreads to the whole body of the plant.

★ There are paths in the roots, stems, and leaves of plants to carry water.

Water is transported in the order of

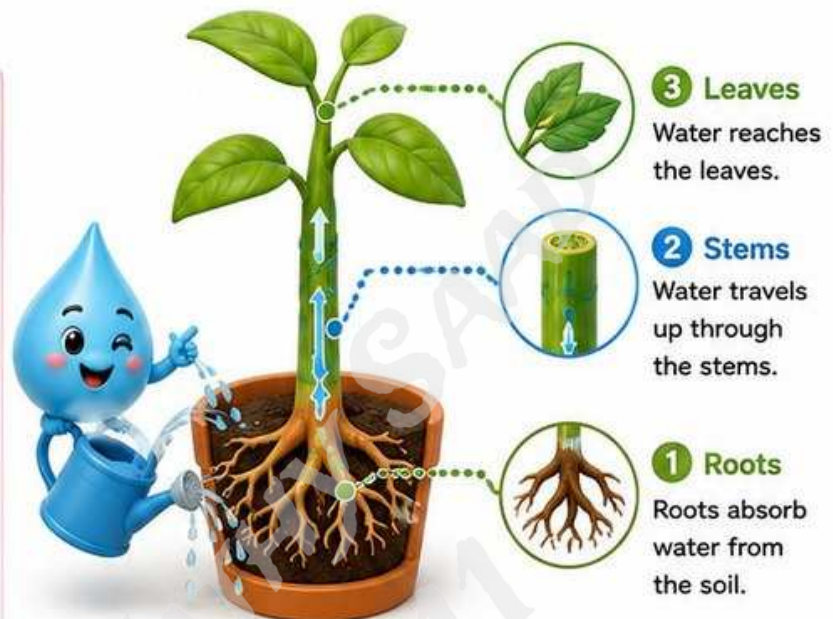
Roots



Stems



Leaves



3 Leaves

Water reaches the leaves.

2 Stems

Water travels up through the stems.

1 Roots

Roots absorb water from the soil.



Warm Up

Let's observe the path of water!

Let's use colored water to visualize where the water passes through.

1 Preparation:



Plant



Colored water



Flask



Cutter knife



Absorbent cotton



Magnifying glass or microscope

2 Experiment:

- 1 Dig up the plant with the soil, and wash the roots with water.
- 2 Put colored water in the flask and soak the roots in it.
- 3 After a few hours, observe the color change in the plant.
- 4 Cut the roots, stems, and leaves with a cutter knife, and observe the cut surfaces.



3 Summary:

- ★ The parts that turned red are the paths for the colored water.
- ★ Let's sketch and summarize.



The red color shows the water paths inside the plant!



Key Fact

Water absorbed by the **roots** travels up through the **stems** and reaches the **leaves** to help the plant grow and stay healthy.





Food Chain

Chapter 7 Food Chain



1 How are living organisms connected by what they eat?



Living things depend on each other for food. This connection is called a **food chain**.



2 Example of a Food Chain



3 Key Points

- Plants make their own food.
- Animals get **energy** by eating other living things.
- If one living thing disappears, it can **affect** the others.



The sun gives energy to plants, and the energy passes from one living thing to another.

4 Think & Share



Humans also live by eating living organisms like plants and animals. Give two examples.

1

2



Science Fact

All living things are connected in a food chain. It keeps nature in **balance**!



7-1 Food Chain

Food Chain

Chapter 7

Point!

How the Food Chain Works

The “eat and be eaten” connection (feeding relationship) between living organisms is called a **food chain**.

- 1 **Plants:** They use sunlight to produce nutrients inside their bodies. This is the beginning of the food chain.



- 2 **Herbivores:** Animals that eat plants. (Example: Grasshoppers, rabbits, etc.)



- 3 **Carnivores:** Animals that eat other animals. (Example: Snakes, eagles, lions, etc.)



The connection is shown using **arrows** like “Grass → Grasshopper → Frog”. The arrow points to the **direction** energy is carried.



Warm Up

Let's complete the connection!

Imagine the connections between living organisms around you and connect the chain.

1 Find the start:

First, find a plant in your garden or a park.



2 Find what eats it:

What kind of bugs are eating the leaves of that plant?



3 Think further ahead:

Are there any birds or lizards that eat that insect?



4 Draw arrows:

Connect the living organisms you observed with arrows, and write down one food chain in your notebook.



Key Fact!

Plants make their own food. Animals get their food by eating other living things. **Energy** moves from one living thing to another.





How are living organisms connected through air and water?



Living organisms, air, and water are connected by **invisible bonds**.



Everything in Nature is Connected!

Air and **water** are needed by all **living things**. They help plants, animals, and humans **survive**.

How Are They Connected?



Plants take in **carbon dioxide** from the air.



Plants absorb **water** from the soil through their **roots**.



Animals eat **plants** for **food** and drink **water**.



Humans and animals breathe the **air** to live.



Key Idea!

Air, water, plants, animals, and humans depend on each other. This is how the **food chain** keeps **life** going!





Point!

Circulation of Air and Water



Connection of living organisms through air

Animals use the **oxygen** released by plants to breathe, and plants use the **carbon dioxide** breathed out by animals for **photosynthesis**.



Connection of living organisms through water

Plants release water into the air through **transpiration**. This water vapor joins the water cycle. Water also evaporates from oceans, rivers, and lakes, rises into the atmosphere to form clouds, and falls as rain. Transpiration is an important part of the water cycle that keeps water moving between living organisms and the environment.



Our lives are constantly supported by the **oxygen** produced by plants and the water circulating around the Earth!



Warm Up

Let's feel grateful for water and air!

1 Check the path of breathing:

Be aware of your own breathing and imagine how "the breath you just breathed out is used for photosynthesis by the tree next to you".



2 Trace the journey of water:

Let's talk about the possibility that the water you drink today was once a cloud, or water that a tree in some country absorbed.



3 Think about the balance:

Let's predict what would happen to the oxygen and carbon dioxide in the air if plants completely disappeared.



Key Fact

Water absorbed by the **roots** travels up through the **stems** and reaches the **leaves** to help the plant grow and stay healthy.





1 Answer the questions.

- 1 (1) What do we call the feeding relationship between living organisms?



- 2 (2) What kind of living organisms are the beginning of the food chain? Choose the correct answer from below.

A Strong carnivores



B Herbivores like insects

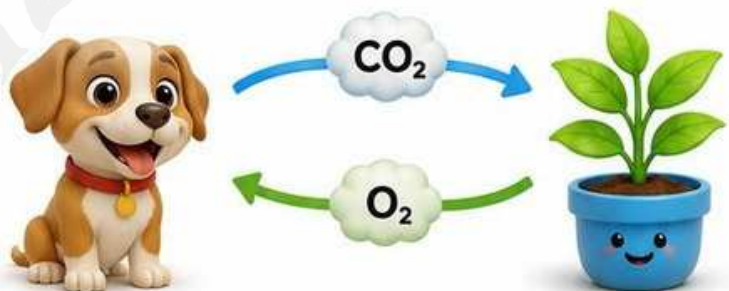


C Plants that produce nutrients using sunlight



2 Answer the questions.

- 1 (1) What gas do animals breathe out and plants take in?



- 2 What do we call the process where plants release water absorbed from their roots into the air as water vapor? Choose the correct answer from below.



Think Smart!

Every living thing needs **air**, **water**, and **food** to live and grow.

A Evaporation



B Transpiration



C Breathing



1 Food Chain

(1) Arrange the following living organisms in the correct order of the food chain and connect them with arrows.



Grasshopper



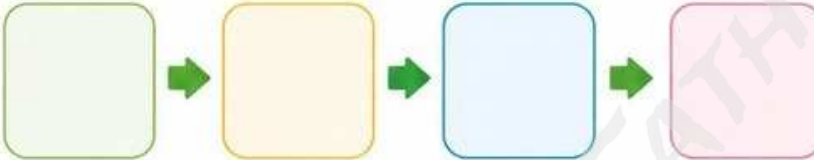
Wheat



Eagle



Frog



(2) Which statement correctly explains the food chain? Choose the correct answer.

A Arrows are drawn from the one that eats to the one that is eaten.

B If carnivores disappear, plants will grow healthier.

C Plants use sunlight to produce nutrients inside their bodies.



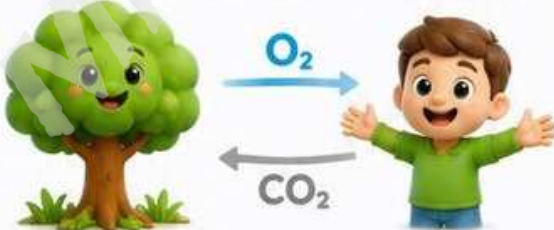
2 Living Organisms and Air

(1) Which statement correctly explains the relationship between living organisms and air? Choose the correct answer.

A Both animals and plants only decrease oxygen and increase carbon dioxide.



B The environment where animals can breathe is maintained because plants release oxygen.



(2) About the connection of living organisms through water, choose the correct word from below to fill in the blank.



The water on Earth is changing its shape and (_____), and it is used repeatedly by many living organisms.

circulating / disappearing / increasing

Science Tip!



Everything is connected! Plants, animals, air, and water all work together so that living things can live and survive.





How are living organisms connected in the Nile River and the desert?



The Nile River Food Chain



Plants make their own food.



Fish eat plants.



Birds eat fish.



Crocodiles eat birds and fish.



Everything in the Nile River depends on each other to survive.



The Desert Food Chain



Plants make their own food.



Insects eat plants.



Birds eat insects.



Foxes eat birds and insects.



Even in the desert, living things are connected in a food chain.



Think & Talk!



Is the king of the Nile River the crocodile?



What is the king of the desert?





Point!

Ecosystems in Egypt

Egypt has completely different food chains in **aquatic environments** (the Nile River) and **arid areas** (deserts).



Food Chain in the Nile River



Algae and water plants



Herbivorous fish
(like the Nile tilapia)



Carnivorous fish
(like the Nile perch)



Top carnivores
(like the Nile crocodile)



Food Chain in the Desert



Desert shrubs and grass



Herbivores
(like grasshoppers and jerboas)



Top carnivores
(like fennec foxes and Egyptian vultures)



Even if the types of animals are different, the chain always starts with **plants** and ends with **large carnivores**.



Warm Up

Let's find the king of the food chain!

1 Observe the Nile River:

Trace the route starting from small water plants all the way up to the big crocodile.



2 Observe the Desert:

Trace the route starting from grass that grows with little water all the way up to birds of prey flying in the sky.



3 Find Similarities:

Let's talk about whether there are any other animals that eat the animals at the top of the food chains.



Key Fact

Food chains always begin with **plants** and end with **large carnivores** in both the Nile and the desert!





Try

- 1 Give one example of a **top carnivore** at the top of the food chain in the Nile River.



- 2 If all the plants in the desert died out, what do you think would happen to the **carnivores**? Write your own thoughts.



Exercise

- 1 Which statement correctly explains the food chains in Egypt? Choose the correct answer from below.

- A In the Nile River, crocodiles eat algae directly.
B In the desert, fennec foxes eat small animals like jerboas.



- 2 Give one example of a **herbivore** that eats plants in the desert food chain.



Did You Know?

Food chains show how living things **depend on each other** to survive.





Let's Expand!

Let's look at the **food chains** in Egypt.



Food Chain 1



Algae



Nile Tilapia



Nile Perch



Nile Crocodile

Food Chain 2



Shrub Seeds



Jerboa



Desert Horned Viper



Fennec Fox

Food Chain 3



Papyrus



Grasshopper



Frog



Egyptian Vulture



Key Fact!

Food chains show how living things get **energy** by eating other living things. Energy moves from one living thing to another.





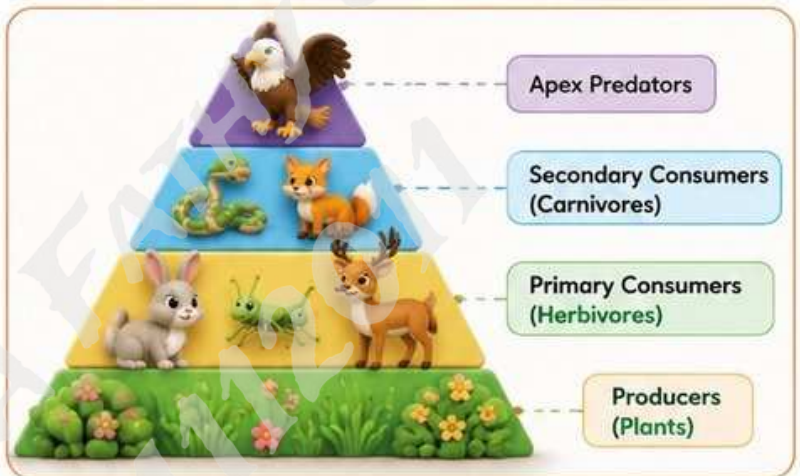
1 It Always Starts with Plants

In Chapters 7 and 8, we learned about the food chain, where living organisms are connected by an **"eat and be eaten"** relationship.



2 The Base of the Pyramid

The diagram of a food chain is called a food pyramid, and the very bottom of this pyramid is always supported by plants (**producers**), which produce their own food from **sunlight**.



3 The Nile's Chain

In the Nile River, there is a beautiful circle of life:

small shrimp eat **water plants**,
fish (like the Nile tilapia) eat the **shrimp**,
 and then **water birds and humans** eat the **fish**.



Key Fact

Every food chain starts with **plants**.
 Without plants, no living thing can **survive**!





The water flowing in Egypt is actually part of a “**global cycle**” that reaches all the way from countries far to the south.



The Desert Hunter Fennec Fox

In the desert where there are **few plants**, animals that eat the small amount of grass seeds or lizards sustain the food chain.

Without consumers like the fennec fox, the **balance** of the desert ecosystem would be disrupted.



Memories of Wadi al-Hitan

Wadi al-Hitan, or the “Valley of the Whales,” is a desert now, but it is filled with **fossils** from when it used to be an ocean! By studying this place, we can see that tens of millions of years ago, the ancient ocean had a complete food chain just like the Nile does today. From the past to the future, the **connection of life** remains unbroken.



Think and Explore!

1 Why is the fennec fox important?

What might happen if there were no fennec foxes in the desert?



2 What can fossils tell us?

What do the fossils in Wadi al-Hitan help us understand?



3 Let's connect!

How are the desert ecosystem and the Nile River ecosystem connected?



Key Fact

Deserts may look empty, but every living thing has a role! The past and present show us that **life** is always connected.



Grouping Solutions

Properties of Solutions



How can we group solutions?

The five kinds of solutions above are all **clear**. How should we tell them apart?



We can group solutions by their properties.

1

Color



All five solutions are **clear**.

Example



Salt water

2

Particles



Particles are so **tiny** we cannot see them.

Example



Sugar water

3

Does Not Settle



Particles **do not settle** at the bottom.

Example



Vinegar

4

Passes Light



Light **passes** through them.

Example



Baking soda solution

5

Does Not Scatter Light



They **do not scatter** light.

Example



Lemon water



Remember

Solutions may look the same, but we can group them by their **properties**.



9-1 Grouping Solutions



POINT!

Acidic, Neutral, and Alkaline



- Solutions can be divided into **3 groups** by how they change the color of litmus paper.



1 Acidic: Turns **blue** litmus paper **red**.

(Example: lemon juice, vinegar, hydrochloric acid)



2 Neutral: Does not change the color

of either litmus paper.

(Example: salt water, sugar water, distilled water)



3 Alkaline: Turns **red** litmus paper **blue**.

(Example: soapy water, limewater, ammonia solution)



Quick Look!

Acidic



Neutral



Alkaline



WARM UP!

Let's group solutions using litmus paper!

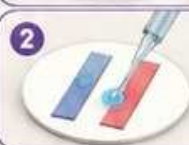
1 Preparation

- Solutions (salt water, carbonated water, dilute hydrochloric acid, baking soda solution, dilute ammonia solution)
- Beaker
- Test tube
- Test tube rack
- Glass rod
- Tweezers
- Litmus paper
- Filter paper
- Safety goggles



2 Experiment

- Put blue and red strips of litmus paper on the filter paper.
- Use a glass rod to add one drop of the solution you want to test onto both litmus strips.
- Check the color change of the litmus strips and group them into acidic, neutral, or alkaline.



CAUTION!

- When changing the solution, rinse the glass rod with water in a beaker and wipe it off every time.
- Make sure to ventilate the room. Also, wear safety goggles.



3 Summary

Let's summarize the results in a table.





What is dissolved in solutions?

Chapter 9

Properties of Solutions



QUESTION

How can we find out what is dissolved in a clear solution?



ANSWER

We cannot see what is dissolved in a clear solution.

So, we need to use some **special methods** to find out.



Can we take out what is dissolved from the solution?



KEY IDEA

The substances dissolved in a solution are **very small** and mixed evenly in the liquid. We need **special methods** to separate and identify them.



Watermarkly



D.M.RAZK

موقع الدكتور محمد رزق معلم الكيمياء التعليمي



Point!

The Identity of Dissolved Substances



By evaporating a solution, we can find out what was dissolved inside.

1 Solids dissolved in water

When you evaporate the water, the dissolved substances (such as salt or baking soda) will remain at the bottom of the dish.



2 Gases dissolved in water

- Even if you evaporate the water, **nothing will remain** because the dissolved substance escapes into the air.
- Sparkling water has carbon dioxide gas dissolved in it.



Warm Up

Let's heat and extract what is dissolved!

Let's extract and observe what became invisible by dissolving in water.

1 Preparation

- Solutions (salt water, carbonated water, dilute hydrochloric acid, baking soda solution, dilute ammonia solution)

• Beaker



• Test tube



• Test tube rack



• Pipette



• Evaporating dish



• Portable gas stove



• Wire gauze



• Safety goggles



2 Experiment

- 1 Use a pipette to transfer the solution from the test tube into the evaporating dish.
- 2 Heat it gently over low heat with a portable gas stove.
- 3 Turn off the heat while a little liquid is still left, and let the remaining heat dry it.
- 4 Observe what is left.



Caution!

- During the experiment, do not bring your face close to the evaporating dish to smell it or breathe it in directly. When smelling, use your hand to waft the smell toward you.



- To avoid burns, do not touch heated objects until they cool down completely.



3 Summary

- Let's summarize what was left in the evaporating dish in a table.
- Also, write down how the solutions look and smell.



Key Fact

Solids remain after evaporation, but gases escape into the air.



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Try

Let's test what you learned!



1

(1) Which is the correct combination for the litmus paper reaction? Choose the correct answer from below.

- A** An **alkaline solution** turns red litmus paper blue.
- B** An **acidic solution** turns red litmus paper blue.
- C** A **neutral solution** changes the color of both litmus papers.

Litmus Paper Reactions		
Acidic solution	Neutral solution	Alkaline solution
		
		
Blue litmus turns red. Red litmus stays red.	No change in both papers.	Blue litmus stays blue. Red litmus turns blue.



(2) What are some neutral solutions? Answer with one example.

2

(1) What are the white solid left at the bottom of the dish when salt water was evaporated?



(2) Why is nothing left at the bottom of the dish when dilute hydrochloric acid was evaporated? Choose the correct answer from below.

- A** Because nothing was dissolved in the dilute hydrochloric acid.
- B** Because what was dissolved escaped as a gas.
- C** Because it melted from the heat.



Think carefully!



Key Fact

When we evaporate a solution, the **solvent** (water) leaves as vapor, and the **dissolved solid** may stay behind.



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EXERCISE



1



(1) What type of solution turns blue litmus paper red?



(2) Soap water turned red litmus paper blue.

What kind of solution is soapy water?

Choose the correct answer from below.

A

Acidic

B

Neutral

C

Alkaline



2



(1) What should you be careful of in the experiment to evaporate a solution?

Choose the correct answer from below.

A

Keep heating on high heat until the bottom of the evaporating dish burns.

✗

B

When smelling, breathe it in directly near the evaporating dish.

✗

C

Turn off the heat when there is only a little solution.

✓



(2) Which of the following solutions leaves nothing behind when evaporated? Choose the correct answer from below.

A

Sugar water

B

Dilute ammonia solution

C

Salt water



3



(3) What is dissolved in carbonated water?

**Key Fact**

Solutions contain different dissolved substances. Some leave solids after evaporation, while others leave nothing behind!



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Chapter 9

Column: The “Chemical Eye” That Sees Invisible Forces



1 The Secret of Solutions and the Pharaoh's Wisdom



Water solutions may look clear, but they hide mysterious properties — being **acidic**, **neutral**, or **alkaline** — that can only be told apart using **litmus paper**.

The wisdom to control these properties has been in Egypt for thousands of years, cleverly used as a magic powder called **natron** to help make mummies.



Natural Alkaline Powder “Natron”:

Ancient Egyptians used a white powder called **natron**, found in desert salt lakes. It was strongly **alkaline** and had the amazing ability to absorb water from the body, making it an essential material for creating mummies that kept their shape for thousands of years.

2 Acids and Alkalis in Our Daily Lives

Even today, we use the power of these properties without realizing it, such as lemon juice (**acidic**) for cooking and soapy water (**alkaline**) for cleaning.



Acidic in Daily Life



Alkaline in Daily Life



KEY IDEA

The substances dissolved in a solution are **very small** and mixed evenly in the liquid. We need **special methods** to separate and identify them.



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2 Diagnosing the Earth and the Nile



In modern Egypt, testing the properties of water solutions is an **important diagnostic tool** to understand the current condition of the land and the Nile River. The color change of **litmus paper** is a scientific language that helps us read important messages from nature to protect our beautiful environment.



The Health of the Soil for Growing Crops

- In the vast fields of Egypt, farmers are always checking whether the soil is **acidic** or **alkaline**.
- By adjusting the soil to the perfect condition for the plants they grow, like cotton and wheat, they cleverly ensure a large harvest of **delicious crops**.



Water Quality Management of the Nile River

- The quality of the Nile River, our water of life, is also scientifically monitored.
- Scientists carefully monitor **wastewater** from factories to ensure it is not strongly **acidic** or **alkaline**, using the power of science to protect a beautiful environment where fish and birds can live safely.



Key Fact

Science helps us read nature's messages and protect our Earth and the Nile.



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Aqueous Solutions and Metals

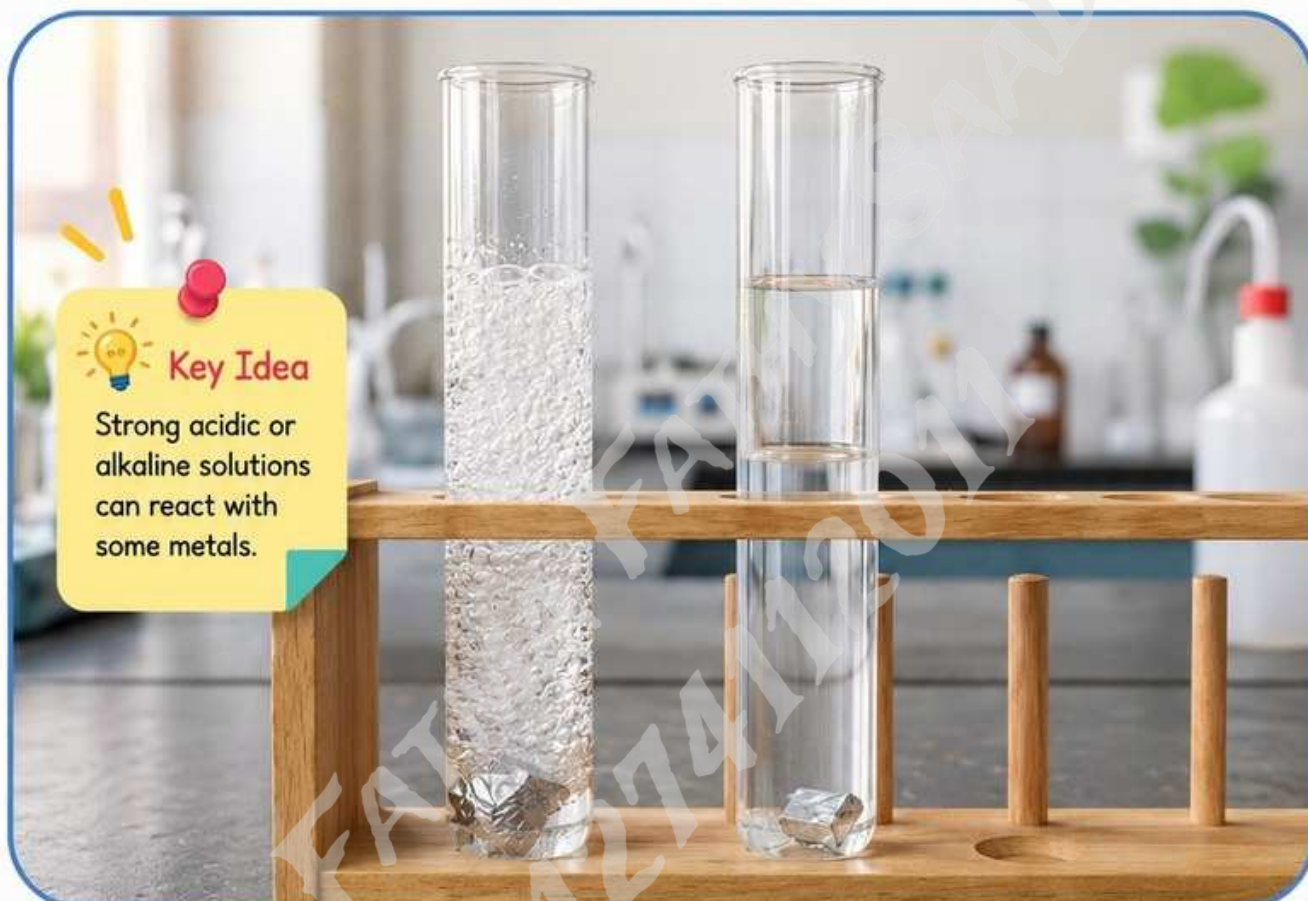


Reaction between Solutions and Metals



Key Idea

Strong acidic or alkaline solutions can react with some metals.



How do strong **acidic** or **alkaline** aqueous solutions act on metals?



There are a lot of bubbles!



I wonder if there is an **aqueous solution** that reacts with metals?





Point!

Properties that React with Metals



Some aqueous solutions have the properties that react with metals.



Hydrochloric acid has the properties that react with aluminum and iron.

When you pour dilute hydrochloric acid on metals like aluminum and iron, the metals **react and produce bubbles**.

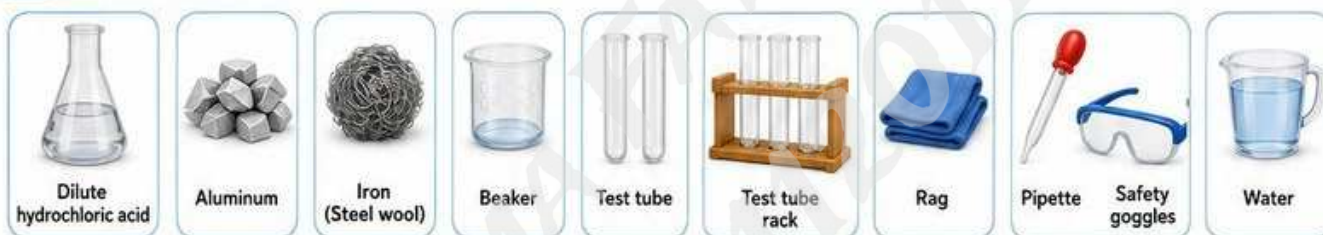


Warm Up

Let's observe changes in metals!

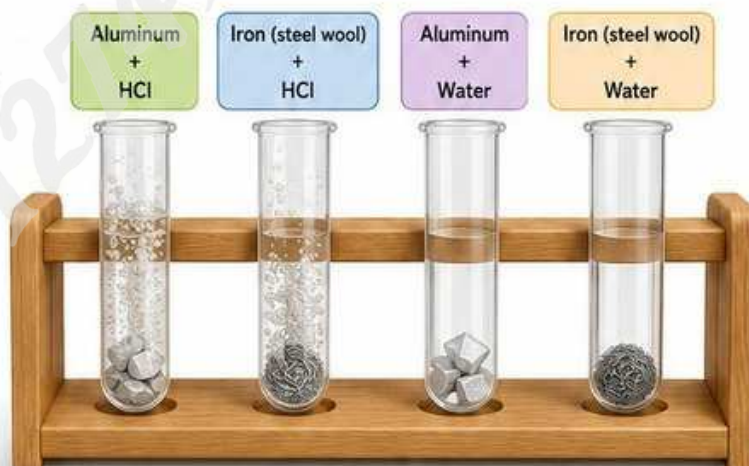
Let's safely check how aqueous solutions react with metals.

1 Preparation:



2 Experiment:

- 1 Cut aluminum into small pieces and put them in a test tube. Tear off a small amount of steel wool, roll it into a ball, and put it in another test tube. Prepare two test tubes for each.
- 2 Use a pipette to add dilute hydrochloric acid to the first set of test tubes. And then use another pipette to add water to the second set of test tubes.
- 3 Observe the changes.



Caution!

- Be careful not to let the liquid touch your skin. If it does, wash it off right away with running water.
- Make sure to ventilate the room. Also, wear safety goggles.



3 Summary:

Let's summarize the results in a table.



Key Fact

Some aqueous solutions **react** with certain metals and **produce bubbles (gas)**.



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Chapter 10

What is Left After Evaporation?

Reaction between Solutions and Metals



QUESTION

What is left after we evaporate the liquid in which the metal reacted?



ANSWER

When we evaporate the liquid, we find that what is left is **NOT** a shiny metal. It is a **dry powder**.



WHAT DID WE LEARN?

- **Evaporation** removes the liquid from a solution.
- After evaporation, a **dry powder** may be left instead of the original shiny metal.
- This helps us understand what happened during the reaction.

What was left is not shiny metal, but a **dry powder**.



KEY FACT

Evaporating a solution helps us **discover** what is left after a chemical reaction!





POINT! Changes in Metals



When you evaporate the liquid of aluminum that reacted with dilute hydrochloric acid, a **white solid** appears.

! Differences from the original metal:

- Appearance: It is not shiny.
- Reaction: Even if you put the remaining solid into dilute hydrochloric acid again, it will not react and produce bubbles like the original metal.

We can say that... the metal changed into a substance with **completely different properties** by reacting with the aqueous solution.



WARM UP

Let's test what the powder really is!



Let's extract and observe what disappeared when it dissolved in water.



Preparation

- The liquid made in the previous lesson
- Test tube rack
- Wire gauze
- Beaker
- Pipette
- Safety goggles
- Test tube
- Evaporating dish
- Portable gas stove
- Dilute hydrochloric acid



Experiment

- 1 Put the liquid in which the metal reacted into an evaporating dish.
- 2 Heat it gently on low heat with a portable gas stove.
- 3 Turn off the heat while there is still a little liquid left, and let the remaining heat dry it.
- 4 Observe what is left.
- 5 Try putting the powder you took out into dilute hydrochloric acid in another test tube. Check that no bubbles come out.



CAUTION!



During the experiment, **do not** bring your face close to the evaporating dish or breathe in the fumes directly.



To avoid burns, **do not** touch heated items until they have cooled down completely.



Do not touch the remaining solid directly with your hands.



Summary

Let's summarize the differences from the original metal in a table.

Property	Original Metal (Aluminum)	Solid Left After Evaporation
Appearance	Shiny	Not shiny, white powder
Reaction with dilute hydrochloric acid	Reacts and produces bubbles	Does not react, no bubbles
What we know	It is aluminum (the original metal)	It is a new substance with completely different properties



KEY IDEA

Evaporation helps us **discover** what is left after a chemical reaction. The new substance can be **very different** from the original metal!





TRY



?

- 1 What happens to metals like aluminum and iron when you pour dilute hydrochloric acid on them?



- 2 What do you think happened to the metal that reacted with the aqueous solution? Choose the correct answer below.

A

It is just hiding and remains as a metal.

B

It reacted with the aqueous solution and changed into something with different properties.



- 3 Which statement is correct about the experiment after the metal reacted? Choose the correct answer below.

A

When evaporated, the original shiny metal comes back.



B

The powder left after evaporation is a different substance from the metal.



EXERCISE

- 1 Which statement correctly explains the properties of aqueous solutions that react with metals? Choose the correct answer below.

A

Hydrochloric acid reacts with iron, but does not react with aluminum.



B

Hydrochloric acid can react with aluminum and iron.



- 2 Is the powder left after evaporating the dilute hydrochloric acid with which aluminum reacted the same as the original aluminum?



- 3 When you pour dilute hydrochloric acid again on the powder that appeared after evaporation, are bubbles produced?



KEY IDEA



Even if a metal reacts and becomes invisible, its original parts are still hidden inside. How to take them out and reuse them — that is where the future scientists will show their skills!





Review & Practice



Let's solve the summary questions about the properties of aqueous solutions.

- 1 What property does an aqueous solution have that turns blue litmus paper red?

Choose the correct answer from below.

A Acidic B Neutral C Alkaline



Turns
blue to red

- 2 When red litmus paper turns blue, what property can you tell the aqueous solution has?

Choose the correct answer from below.

A Acidic B Neutral C Alkaline



Turns
red to blue

- 3 What is the gas dissolved in carbonated water?



- 4 What is left when you heat the dilute hydrochloric acid with which aluminum reacted in an evaporating dish?

Choose the correct answer from below.

A A white solid that is not a metal
B The original shiny aluminum
C Nothing is left.



- 5 What happens when you pour dilute hydrochloric acid again on the powder remaining after evaporation?

Choose the correct answer from below.

A It explodes.
B It reacts and produces bubbles just like the original metal.
C No bubbles are produced.



- 6 Which statement is correct about the phenomenon of metals reacting with aqueous solutions?

Choose the correct answer from below.

A The metal is just changing its shape, and its properties have not changed.
B The metal changed into a substance with different properties.



- 7 What is the last thing you should do for safety in the experiment of evaporating an aqueous solution?

Choose the correct answer from below.

A Turn off the heat while a little liquid is still left.
B Keep heating on high heat until it is completely dry.



Turn off
the heat!



Key Reminder

Be careful, follow the rules, use the right tools, and always think like a scientist!



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1 The Mystery of Gold That Shines Forever ✨

The chemical reaction where strong, hard metals **react** with an **acid** and produce **bubbles** gives us an important clue about Egypt's proud golden history.

Finding out the true nature of the violent changes we saw in the experiment is the key to solving the **mystery** of why the Pharaoh's mask continues to shine even after thousands of years.



Why the Pharaoh Chose Gold:

The reason Tutankhamun's golden mask is still beautiful today is because **gold** has an extremely stable property — it **does not react** with strong solutions like hydrochloric acid.



2 The Energy Released When Metals React



The bubbles that are produced when iron or aluminum reacts with dilute hydrochloric acid are actually **hydrogen gas**.

When a metal changes into another substance, a large amount of **chemical energy** is at work to create a new gas.



Bubbles =
Hydrogen gas

Key Fact!



Some metals **react** with acids and **release energy**.

Gold is special because it does not react with strong acids — that's why it lasts forever!





2 The Power of Recycling to Reuse Resources

The process where a metal reacts with a solution and then is left behind in a different form after the solution evaporates proves that the substance has not disappeared from the world. This ability to understand **"invisible changes"** is incredibly useful in modern factories and in the world of recycling, where we use the Earth's limited resources over and over again.



SECRETS OF INVISIBLE CHANGE



• The Technology of Evaporating to Recover:

The technology of evaporating water from a solution containing the reacted metal to extract the solid is used in factories to make very pure materials.



• Egypt's Future and Recycling:

Instead of throwing away old metal items, we can use the power of chemistry to turn them back into clean materials. The useful change you have learned will be a great power to reduce trash and make Egypt's future green and strong!



WARM UP Let's test what the powder really is!

Let's extract and observe what disappeared when it dissolved in water.

1 Preparation:

- The liquid made in the previous lesson
- Beaker
- Pipette
- Test tube rack
- Safety goggles
- Test tube
- Evaporating dish
- Portable gas stove
- Dilute hydrochloric acid
- Wire gauze

2 Experiment:

- Put the liquid in which the metal reacted into an evaporating dish.
- Heat it gently on low heat with a portable gas stove.
- Turn off the heat while there is still a little liquid left, and let the remaining heat dry it.
- Observe what is left.
- Try putting the powder you took out into dilute hydrochloric acid in another test tube. Check that no bubbles come out.



CAUTION!



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3 Summary: Let's summarize the differences from the original metal in a table.

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What we know	It is aluminum (the original metal)	It is a new substance with completely different properties

KEY IDEA

Evaporation helps us **discover** what is left after a chemical reaction. The new substance can be **very different** from the original metal!





Lab Safety and Professional Tools



In 6th-grade experiments, we handle fire and strong chemicals (like hydrochloric acid). This is a guide to help you do **experiments safely** and get the correct results.

1

Handling Chemicals



- **Wear safety goggles:**

Always wear them to keep solutions like hydrochloric acid from getting into your eyes.



- **How to smell chemicals:**

Waft the smell toward you with your hand. Do not put the chemical too close to your nose.



- **If you spill a chemical:**

Wash it off right away with lots of water and tell your teacher.



Key Rule ★

Be careful, wear safety gear, and always follow your teacher's instructions for a safe and successful experiment!

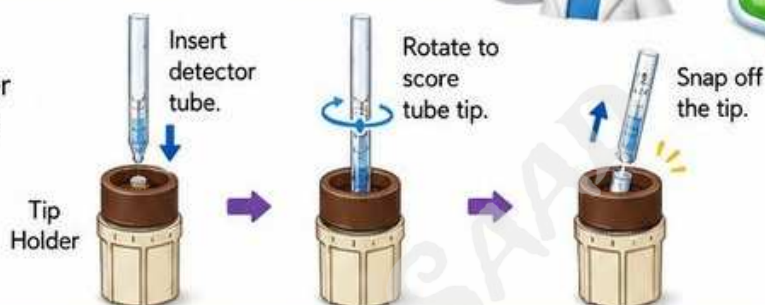


2 How to Use a Gas Detector Tube



1 Snap off both ends:

- Use the special tip holder to snap off both ends of the detector tube.



2 Check the arrow and attach the tube:

- Push the detector tube firmly into the opening of the gas sampler so the arrow (→) points toward the sampler.

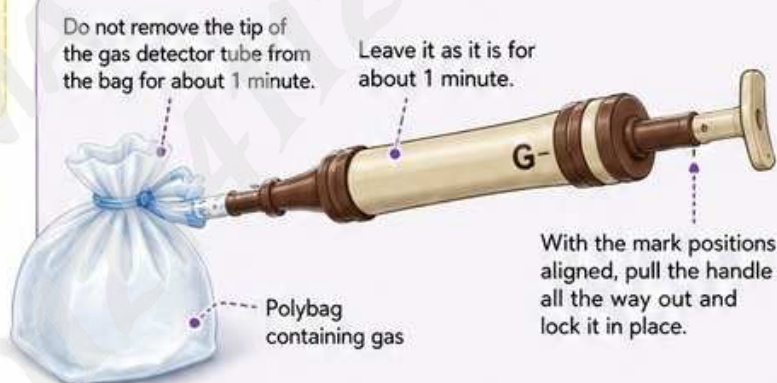


Caution!

- Always put on the rubber cap so you do not get hurt by the broken glass edges.

3 Draw in the gas and wait:

- Pull the handle all the way out at once and lock it in place. Wait for the required time (about 1 minute).

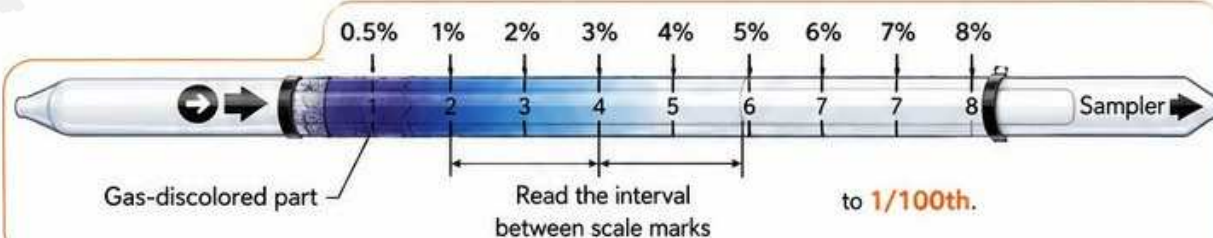


4 Read the scale:

- Read the scale where the color has changed.

Caution!

- Oxygen detector tubes get hot, so do not touch them right away.
- Throw away used detector tubes exactly as your teacher tells you.



Key Point

Always follow each step carefully to get an accurate and safe result!



موقع الدكتور محمد رزق التعليمي



امسح الباركود بالمويل لتثبيت
التطبيق وتحميل كل الملازم مجاناً وبسرعه



حمل التطبيق الآن



كورسات ونتائج امتحانات



ملازم ثانوي



ملازم اعدادي



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